SCIENTIFIC AMERICAN

USING AN ABANDONED QUARRY FOR THE STORAGE OF COAL—[See Page 222.]

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Typical small town landing and warehouse on the Mississippi. These will soon be replaced by modern structures

Primitive harbor at Baton Rouge, La. Fast steel barges cannot operate at a profit under these conditions

Coming Restoration of the Mississippi as an Important Artery of Commerce

By O. R. Geyer

CAN the Mississippi river once more become an important highway of commerce?

Experienced river men who have been watching signs of the coming restoration of inland navigation on the river believe that it can and that the day is not far distant when the Father of Waters will be restored to the proud position it once held as the nation's greatest artery of commerce. After 30 years of inaction and failure to grasp the possibilities in the situation, steps have been taken to revive navigation on a large and dependable scale, and in the Spring the first of the 36 fast, steel barges now being built will begin plying between New Orleans and Minneapolis.

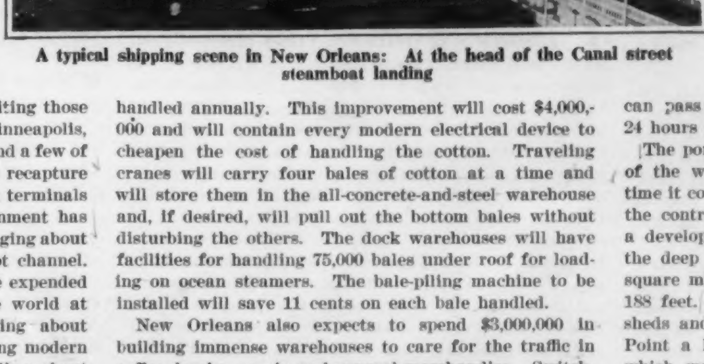
Some of the more progressive terminal points along the river have set about finding river navigation where they lost it—failure to provide modern, cheap terminals to compete with the railroads. New Orleans is the leader in this movement and is spending nearly $100,000,000 in preparing the port for the expected revival of navigation. To-day the snagged, shoal-marked river exists only in the pages of Mark Twain's stories or in the memory of the few remaining pilots and river men of the turbulent days on the river, and now it is as easy for the captain to steer his course down the 2,000 miles of waterway as it is to make his way down the main street of his home town.

The primitive river front wharfage facilities and the lack of modern coördinated terminals have done more than anything else to postpone the new era in navigation on the Mississippi. Since the railroads came with better and cheaper terminal facilities many years ago, there has been no really determined effort to take advantage of the vast opportunities awaiting those making proper use of the river-way. Minneapolis, Davenport, St. Louis, Quincy, New Orleans and a few of the larger ports have taken definite steps to recapture the river trade thus lost. When these modern terminals are completed they will find that the Government has more than kept pace with their efforts in bringing about the realization of the long-dreamed-of six-foot channel.

Nearly $60,000,000 has been spent or will be expended in building one of the greatest ports in the world at New Orleans. Davenport, Iowa, is spending about $1,000,000 in building a sea wall and installing modern terminal facilities, and Minneapolis is spending about $300,000 in building a river terminal. A Government dam will give that city an average of 8 feet of water off the new wall, so that some time this year Minneapolis actually will become the head of navigation on the river. St. Louis is building the first unit of a modern coördinated river-rail terminal, and Muscatine, Iowa, has appropriated a large sum for the first unit of a concrete terminal.

One of the marvels of the long fight for the restoration of river traffic has been the preparations made by the city of New Orleans in the last ten years for handling the immense volume of business expected to come down the river. The Federal Government has spent $18,000,000 in building a deep sea channel to the Gulf of Mexico, a distance of 120 miles, and more than $2,000,000 in bank revetment and harbor improvements, or a total of about $20,608,000. The greatest steamships in the world may steam up the river a distance of 260 miles, or more than 40 miles above Baton Rouge, and great oil tankers and freighters from all parts of the world do an immense business on the lower river.

The greatest share of the expense of improving the river and port has been borne by New Orleans and the state of Mississippi, the latter through a number of bond issues. The city has spent $4,465,000 in building a modern system of docks, sheds and wharves, and now is building a mammoth cotton warehouse, the first unit of which has been completed. There will be storage room of 100 acres, and 2,000,000 bales may be handled annually. This improvement will cost $4,000,000 and will contain every modern electrical device to cheapen the cost of handling the cotton. Traveling cranes will carry four bales of cotton at a time and will store them in the all-concrete-and-steel warehouse and, if desired, will pull out the bottom bales without disturbing the others. The dock warehouses will have facilities for handling 75,000 bales under roof for loading on ocean steamers. The bale-piling machine to be installed will save 11 cents on each bale handled.



A typical shipping scene in New Orleans: At the head of the Canal street steamboat landing

New Orleans also expects to spend $3,000,000 in building immense warehouses to care for the traffic in coffee, lumber, grain and general merchandise. Switching charges have been reduced from $12 to $2 a car by the municipal belt line railroad and free terminal facilities will be given river boats, according to present plans. A channel connecting Lake Pontchartrain and the river will be built by the city at a cost of $2,500,000 to provide waterway frontage for many private firms. This is not the entire sum the dock board will have at its disposal, for there still remains a bond issue of $25,000,000 to be disposed of as the proceeds are needed for the continuation of the harbor improvement scheme. The Belt Line railway is spending $1,500,000 in providing better facilities for the handling of the freight business which is expected to begin coming down the river this year.

Within a few years' time New Orleans will have spent $60,500,000 in river and harbor improvements, which will give it one of the greatest ports in the world. This does not include $30,000,000 expended within the city itself to provide better sewerage and water systems. The work of rat-proofing the city will cost $7,500,000, so thorough are the preparations being made for the revival of inland navigation.

The work that New Orleans is doing supplements that of the state of Illinois in digging an 8-foot barge canal from Chicago to Davenport. The Government has co-operated even further by building the world's greatest inland drydock at Keokuk, which can care for three of the largest river boats at one time. Even more important work is being done in blasting a 6-foot channel through the dangerous LeClaire rapids below the town of LeClaire, Iowa, on which more boats have come to grief than through any one other agency on the river. The LeClaire canal will be 250 feet wide and about 3 miles long. The Iowa shore will be used for one bank of the canal and a cofferdam is being built on the outer, or river side. When the work of blasting and excavating the rock is completed, which will take another year, a dam and locks will be erected at the lower end of the canal.

The LeClaire rapids are the last great obstacle in the way of a 6-foot channel. Under present Federal rules, ships are forbidden from trying to pass the rapids in the night time, because of the great danger. Five years' time probably will be required before the large river boats can pass through the canal at any time during the 24 hours of the day.

The port of New Orleans will be one of the wonders of the world when fully completed. At the present time it consists of 41.4 miles of river frontage, all under the control of the city dock board. This harbor has a developed area of more than 7 square miles, while the deep water area within the port limits totals 11 square miles. The harbor varies in depth from 40 to 188 feet. In time, should conditions warrant it, steel sheds and wharfage facilities could be extended from Point a la Hache to Baton Rouge, about 178 miles, which would provide a deep waterway harbor of 85 square miles. The public wharves have a platform area of 3,777,166 square feet, and steel sheds three-quarters of a mile long protect a wharf area of 2,558,906 square feet.

The methods of handling freight, once it reaches the "Valley Gateway," as New Orleans is known, will be the most improved known to the world. The gang plank, a representative of the present day inefficiency

(*Concluded on page 228*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Secretary Daniels and the Naval Emergency

TO all patriotic Americans whose eyes are unclouded by party politics, it is perfectly clear that the United States navy is confronted by one of the most serious crises in its whole history. In a matter involving the violent death of over one hundred American citizens we are to-day engaged in critical negotiations, during which the relations of this country with the second greatest naval power in the world have, more than once, been strained almost to the breaking point. Moreover, the naval power in question believes that, because of the ammunition question, it has cause for a deep-seated grievance against this country. History teaches us how readily the seeds of bitterness may become the seeds of war, and hence the question of the relative strength of our own navy and that of the nation in question becomes of paramount importance.

How, then, do matters stand? What is the relative strength of the United States navy and that of Germany? It is readily stated.

To Germany's great fleet, *in commission* to-day, of twenty-two dreadnoughts we could oppose but eight, and by the summer of this year but eleven.

Among those twenty-two dreadnoughts are five battle-cruisers of twenty-eight knots speed, and against these we could oppose not a single one.

Against Germany's fleet of a dozen or more up-to-date, twenty-eight knot scouts we could oppose only three of a slow and obsolescent type.

And against Germany's still numerous fleet of large, able, seagoing submarines, well seasoned by months of arduous war service, we could oppose a fleet of small, non-seagoing submarines, of such doubtful utility that, in the opinion of our seagoing officers, they should never venture far afield from their home ports.

Thanks to the efforts of patriotic societies, such as the Navy League and the National Security League, these facts have been brought home to the American people. A demand has gone forth that the question of the defense of the country, both naval and military, shall be lifted up out of the realm of party politics, and debated from the patriotic standpoint of the highest good of the nation. It is demanded, furthermore, that the plans of defense of the naval and military experts of the country shall be brought out of the pigeonhole and put into practical operation.

So far as the navy is concerned, it is now well understood by the country at large that if the plans of the General Board had been followed our navy would to-day be of equal strength to that of Germany. Owing to the indifference of Congress, the Navy Board plans have been ignored for the past ten years, with the result that we are deplorably lacking in naval strength.

If Secretary Daniels could have had his way, the plans of the Board would have been ignored this year; but, yielding to the public demand, Mr. Daniels, who at first suppressed the General Board's report, has now made it public, and it is revealed that the Board asked for a far larger increase of the navy this year than is called for by the so-called five-year program of Mr. Daniels.

The five-year program is misleading; for it gives a false impression of immediate naval increase. It will be eight years or more before all the ships proposed will have gone into commission, and because of the naval activity of other nations, it will not only fail to restore our navy to second place, but we shall have fallen even lower in the scale than we stand to-day.

We are ten battleships behind the General Board's program, and the deficit should be made good at once. This can be accomplished during the next two years, if the present administration will invite the coöperation of the great shipbuilding firms of the country, which, if they could be assured of steady work and fair treatment, stand ready to enlarge their building ways and add to their shipbuilding plants.

It is because Great Britain has encouraged her great private shipbuilding firms to take naval contracts and has treated them with reasonable business confidence and courtesy, that she possesses such a magnificent navy. Had it not been for her coöperation with the private yards, Great Britain would be blockaded at this hour and the Allied Cause would have lost in the great war. It is no exaggeration to say that the private shipbuilding firms of Great Britain have saved the British Empire from disaster.

We beg to ask what has been the attitude of the present Secretary of the Navy with reference to conditions in this country? Has he been actuated by that broad, patriotic and unselfish motive which alone could secure adequate results? It has been evident from the beginning of his administration that the Secretary of the Navy was under the sinister influence of the Bryan régime, which has been in so many respects detrimental to the country.

The Secretary's animosity against private yards and private shipbuilders has been manifest from the first. At a time when every effort should be made to develop and upbuild our private shipbuilding yards the Secretary has been manifesting a hostility toward them and toward the shipbuilding interests of the country which is not in harmony with the desire of the people to see our fleets, naval and commercial, extended upon the high seas.

The ostensible reason given for this policy on the part of the Secretary is to introduce economies and to develop the resources of the Navy Yards. There is no reason why our yards should not be maintained in a state of high efficiency, but there is every visible reason why both our private yards and the navy yards should be simultaneously encouraged in every possible way, and it is only by such encouragement and support on the part of the Government that the desired results may be obtained.

The Secretary's hostility to the private firms has led to an inexcusable delay in the construction of two of our latest battleships, Nos. 43 and 44, which were authorized by Congress a year ago. He made it his business to find fault with the bids of the private shipyards, and made this the excuse for having them built in navy yards. So one ship is to be built at the New York yard, *when the ways have been vacated by the "California," now building there*, and the other ship is to be built at the Mare Island yard, San Francisco, *after a new ways has been prepared and the proper plant erected there.*

And thus, in spite of the fact that the nation is crying out for the immediate increase of our navy, Mr. Daniels delays the construction of these ships by a good year and a half.

Furthermore, although the navy yard work is excellent, it is more costly than private work. The estimates showing that it costs no more are fictitious; for the navy yard never includes in the cost the heavy overhead charges which form one of the principal items in estimating the cost of privately built warships.

President Wilson has spoken eloquently in favor of a strong navy. The question naturally suggests itself whether the plans of the Administration can be adequately followed out without some radical change being made in the methods and policies which have been pursued by the Secretary of the Navy during the present Administration. No satisfactory explanation has been given by the Secretary to those who are anxious to see the United States navy maintain a proper and adequate position, of the delay of nearly two years which will result from his fatuous policy.

Cremation versus Burial

EMERSON, in the diary of his European trip, noted that the French have engraven on the tombstones of their dead, "Here Lies——"; our American custom, "Here Lies the Body of——" is more consonant with the ever impressive statement, "there is a natural body and there is a spiritual body," in the service for the dead. In weighing the comparative methods of cremation and burial this beautiful Pauline sentiment should go far to remove pious prejudice to incineration. Is not, after all, material life from the cradle to the grave, but a slow oxidation, a continuous process of cremation? There is still a vestige of the theological view that the material body should remain whole until the last trump, that it should not appear otherwise in the presence of its Maker. But this is inconceivable of any body that has been beyond several decades in the grave. Yorick's skull becomes hopelessly intermingled with the spine of an erstwhile neighbor, the thigh bone of another; bodies autopsied by physicians are thereafter no longer whole. The gruesome idea need be no further pursued. On the other hand the ashes of the dead could be perpetuated so long as any memory of the life representing it would endure; while the spiritual body may be believed to remain whole perpetually. Will not then the reverent, on taking thought, find the columbarium preferable to the grave?

Cremation obtained among many ancient peoples. Especially did the Greeks find spiritual grandeur in the concept of the soul arising from the ashes of the dead—the natural body—into the empyrean, to dwell thence forth with the stars. Cremation was indeed an honor denied the bodies of suicides, those who had been struck by lightning, and others deemed to have forfeited the favor of the gods.

Should religious objection to cremation be removed, there would still have to be considered the facility it is assumed to afford murderers and other criminals for the concealment of their crimes. But adequate safeguards can be, indeed are, legally established. In England no human body may be cremated until two independent medical certificates have been given. In the event of doubt ample provision is made for postmortem examination.

Thus there can remain no other reason why cremation should not be preferred to burial; while there are peculiar objections, besides those mentioned, to burial—a slow process, most repugnant to the imagination, and inspiring, as it certainly did under the asceticism of the middle ages, much occasionless horror of death, a natural biologic phenomenon. How dangerous burial is to the living, especially in large cities and where graveyards are contiguous to human habitations, all health authorities are fully aware.

Cremation is indeed a method no longer on trial; it is established in many places throughout Christendom. A point, however, is demonstrated in the experience of the Cremation Society of England, which was founded in 1874: in the hope of interesting the poor (who are very prone to spend far more than a right proportion of their means on funerals) this society made its fee $25—a sum several times cheaper than the cost of the burial. Yet this poetic manner of disposing of the beloved dead has thus far, in England, found favor least among the poor; and chiefly among the professional, the intellectual and the well-to-do.

War and the Medical Profession

PREVIOUS to the fighting now going on in Europe it cost, in modern warfare, about $15,000 to kill a man; in the Boer mix-up this item came higher, $40,000; the Balkan row with Turkey was conducted more reasonably—$10,000 burned up in making one man *canonen futter*. What the price now is no one can at present compute accurately; but the various peoples now in conflict are going to have plenty of time in which to count the cost. Surgeon-Gen. Gorgas, then Col. Gorgas, of the United States Army Medical Service, during the building of the Panama Canal, saved human life among its builders at the actual cost of $2.43 the individual. Sanitation in the Canal Zone under his management took up just 5 per cent of the total canal building expenditures. Nor could that constructive work have been accomplished—every one knows how the French under de Lesseps failed at it—had not devoted and zealous physicians, beginning with Finlay of Havana, so magnificently and with so much altruism, suffering and martyrdom, led up to and applied the discoveries and the resources of modern medical science to the colossal enterprise. The medical philosophy is indeed all for construction rather than for destruction, for reparation than for devastation. Doctors do not kill—not deliberately. Some 30,000 clergy are reported to be fighting in the French trenches—all good men, and true enough, to their country, if not to their calling, though there is probably not one doctor engaged in the like business in all Europe to-day, as many thousands, at least, are crippled, or are killed or dying in this war, while engaged in patching up the wounded, of either or any side or army indifferently; in treating camp infections, or while crawling, snake fashion, between trenches, in the hope of applying first aid to the injured and to gather them into motor ambulances. Nor has any discovery in medical science ever been utilized for the destruction or harming of any enemy.

It is in such spirit that the Medical Brotherhood for the Furtherance of International Morality has been formed—whose aim is to work for, and to keep working for, world-wide and continuous peace. It hopes to exert its influence on the ground that medical science knows no rational or racial limitations, and would have affiliations no less broad, no less circumscribed, than the universe. Lest some subterranean game perversive of American neutrality be suspected, it is expressly stated not to be the Brotherhood's object to exert its influence during the present war. It is, for the present, desired merely to bring to the full consciousness of the medical profession the exceptional moral position which all civilized nations, even while at war, permit and expect medical men to occupy—at least as long as they remain physicians and act in that capacity. This consciousness cannot fail to elevate the moral standards of physicians and, at the end of the present war, a humanitarian body such as this, if already in existence and prepared for service, might and could be of the greatest usefulness in many ways.

Automobile Notes

Automobiles for Battleships.—Following the successful use of an automobile by the commanding officer of the battleship "Maryland," other warships of the United States Navy are to be similarly equipped. The automobile on the "Maryland" is the personal property of its captain, but there is a movement on foot to make a medium-priced touring car the regular equipment of ships going on long cruises. "Land launches" the sailors have called the motor cars, as they are used both for the official and social calls of the officers.

Vacuum Brake for Light Cars.—Tests made recently in England with the Gattrell vacuum brake have shown it to be highly effective on light automobiles, the only essential to their use being the running of the engine. The brake is operated by means of a control valve, which creates a depression in the cylinder, several pounds lower than the outside atmosphere, the pressure of which forces the cylinder piston towards the back of the cylinder, thereby drawing on the brake. The strength of the braking effort is practically controlled by the speed at which the engine is running. The faster the motor has been running at the moment of braking, the greater the power exerted on the brake levers.

What Becomes of Old Cars?—It has generally been assumed that when an automobile begins to show its age it gravitates to the rural districts, but the observing traveler knows that the average farmer likes a new car as well as the city man; it is evident that the fate of used cars, and the reason for the comparatively strong price maintained on them, must be sought in other directions. Many second-hand cars are bought by small tradesmen, who convert them to commercial uses; but by far the larger number return to their makers, or to the various branches, where they are dissected for the many parts that, with a little cleaning, can be used again, thus freeing the shops from the necessity of turning out quantities of parts for replacement stock.

Rifle Bullet Wrecks Armored Car.—How a rifle bullet accidentally wrecked a large armored *Austin* car, equipped with two machine guns, is related in the report of the Hungarian officer, Dr. Aladar Szelnar, to the General Staff. The car, trusting to its strong steel armor approached the positions of the Hungarian riflemen to within 300 yards and opened a murderous fire on them. In the course of the heavy fusillade a bullet from one of the rifles entered through a small crack between plates, and cut the ignition cables at the point where the four wires to the cylinders begin to branch out. When the Austrian artillery finally got the range of the armored car, it attempted to escape, but the motor wouldn't explode. The entire crew of two officers and five men was captured—because of the lucky cutting of the ignition cable.

Road Repairs.—Reports on road work for the past year state that repairs and maintenance cost one third as much as was spent for new roads, and it is pointed out that this is too great a sum. As a matter of fact such a comparison is misleading, for the repair account should properly be compared with the total expenditure for road building. There is little doubt, however, but that the cost of repairs is too great, and the reason is not wholly because the original road was of the wrong kind, or improperly built. Every tourist knows that it is the common custom of those in charge of the roads to allow them to wear almost to the point of disintegration before making any repairs, and then the expense of putting them into good condition again is much greater than would have been the case if the surface had been constantly and systematically maintained. Under present methods it looks as if our roads would have to be practically rebuilt several times before the simple lesson that prevention is cheaper than cure is learned.

Abolishing the Grease Cup.—In the gradual evolution of the modern automobile the original "oil hole" was soon superseded by the oil cup, and the screw-down grease cup, which undoubtedly was a great improvement. Now there has been patented a new device which bids fair to supersede grease cups—at least on automobiles, and probably also on other machinery. This novel device is patented in Great Britain and is an adaptation of the well-known collapsible lead capsules, so widely used for artists' colors, druggists' products, paste, etc., in the United States. The capsules are provided with a screw thread which is screwed into an adapter, which in turn is fastened to the part to be lubricated. The lead capsule and the brass adapter make a tight joint, and all that is necessary is to apply pressure from time to time, as desired. When the grease capsule is emptied, one merely unscrews it and puts a new one in its place. No refilling is necessary, and the pressure of the fingers is usually sufficient to force the grease into the bearing. Anyone who has attempted to fill an ordinary grease cup will appreciate this suggestion.

Science

Zoological Studies Under the Harriman Fund.—For a number of years Dr. C. Hart Merriam has been making, with the aid of the income from a fund established by Mrs. E. H. Harriman, an exhaustive study of the big bears of America, and this investigation is now practically complete. It appears that there are about 38 species and subspecies of true grizzlies, representing a dozen groups, and about ten species of brown bears, representing five groups. Dr. Merriam will now turn his attention to other fields of biological research.

Combined Vaccines for Several Diseases.—According to a very interesting report by Dr. Aldo Castellani, quoted in *Public Health Reports* from a British official source, protection against a number of diseases may be conferred upon a person by the use of several vaccines at one time without any greater inconvenience than is ordinarily caused in being vaccinated to secure protection against one disease. Dr. Castellani began experiments in this line at Bonn in 1901-02, when he demonstrated "that in inoculating an animal with two or three species of bacteria, provided a sufficient minimum quantity was given, agglutinins and immune bodies for all the germs were elaborated, the amount of agglutinins and immune bodies elaborated for each germ being nearly the same as in animals respectively inoculated with only one species." He enumerates nine combinations of vaccines that he has used on human subjects, and states that all are harmless.

Recent Explorations in Brazil.—Mr. Roosevelt has communicated to the American and the Royal Geographical Societies information received by him from Brazil concerning recent explorations in the drainage basin of the Rio Theodoro, the scene of his own explorations. An expedition was sent out about a year ago, under Lieutenant de Souza, to explore the Rio Ananás, or Pineapple River, which now proves to be identical with the Cardosa, of Roosevelt's maps, emptying into the Theodoro in 10 deg. 58 min. S. It is one of the headwater branches of the Theodoro, but not the major tributary that it had been thought to be. The expedition was a disastrous one. After suffering from shortness of food and illness, the party was attacked by Indians, and the leader was drowned after being wounded with arrows. The party became scattered, and apparently only three of the ten *camaradas* who had started with de Souza, finally reached the Dúvida, and ultimately got back to civilization.

Double Report from Firearms.—A paper by M. Agnus, in the *Comptes rendus*, describes and discusses the phenomenon, frequently noted during the present European war, of a double report from a gun. The explanation depends upon the fact that, in these cases, the velocity of the projectile is considerably greater than that of the explosion wave starting from the muzzle at the same time with the projectile. If the observer is near the trajectory of the projectile, his first aural impression is due to the disturbance arising from the passage of the latter through the air, while the second is due to the arrival of the explosion wave. In the case of the 75 mm. shrapnel shell, the writer calculates the time intervals between the reports, at various distances in front of the cannon, as follows: 100 meters, 0.1 sec.; 500 m., 0.5 sec.; 1,000 m., 0.8 sec.; 2,200 m., 1.2 sec. For greater distances the projectile loses sufficient headway, on account of the air-resistance, to diminish the time interval. M. Agnus suggests that the violent detonation so often reported in connection with brilliant meteors, and commonly attributed to the explosion of these bodies, may often be due rather to the violent disturbance of the air by the passage of the meteorite through it.

The Crushing of a Copper Tube Lightning Rod by a discharge of lightning has recently been investigated by Prof. W. J. Humphreys, of the U. S. Weather Bureau, who draws some interesting conclusions as to the strength of current and the amount of electricity involved in producing this effect. The damaged rod was submitted to the Bureau, together with an undamaged rod of identical size and pattern. The crushed tube was five feet long, and constituted the terminal of the lightning conductor. It was completely collapsed, except for a part of the conical tip, which was a separate piece of metal. Parts of the rod were fused, and the brazing solder along the joints was almost completely volatilized. Prof. Humphreys concludes that the collapse was an example of the "pinch phenomenon"; *i. e.*, a squeezing effect due to the interaction of the magnetic fields set up by the current. The walls of the tube were, of course, weakened by heating, and hence more susceptible to the effects of this squeeze. From the amount of fusing and crushing, and the known physical constants of the metal, the strength of current appears to have been of the order of 90,000 amperes; and assuming the duration of discharge to have been 0.01 second, the quantity of electricity would be about 900 coulombs.

Inventions

A Pressed Steel Stairway.—A newly patented pressed steel stair consists of a tread and riser in a single sheet, the tread being formed with a curved nose and the riser terminating in an angularly extended lip, these two parts of adjoining steps locking together when in place.

Projecting One Film on Two Screens.—One moving picture apparatus may be made to serve two audiences by means of a recently patented arrangement. In one wing of an "L" shaped hall the picture is shown on a screen as usual, while the audience in the other wing views the reflected picture on a mirror placed back of the fabric curtain and at an angle of forty-five degrees to it.

Electric Fuses Sealed in Place.—A system of sealing electric fuse plugs has been devised for the use of central station managers to prevent unauthorized persons from tampering with the circuits. The new fuse is of porcelain, with a slotted head, so that a wire may be passed through two more fuses. When the ends of this wire are sealed with a piece of soft lead any effort to substitute one fuse for another or to put a fuse in place when the service has been cut off for any reason, will be detected by the employes of the electric company.

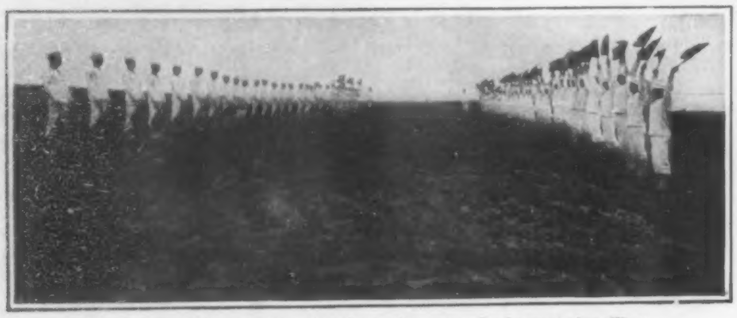
Sanitary Device for Dentists.—Among the patents recently granted is one for a corrugated paper covering to be placed over the exposed parts of a dentist's implement, for the purpose of protecting one patient against contamination by contact with the metal part which has been in the mouth of another. While it is true that sterilization is largely resorted to at the present time, there are many implements that cannot be readily sterilized because of their delicacy; but one of these paper coverings used on each occasion places the dentist's implements beyond suspicion.

One Light for Several Rooms.—The efficiency of the electric lamp is doubled or trebled, as the case may be, by means of a system recently patented by William M. Grosvenor, of Grantwood, N. J., who proposes to dispose of the source of illumination in an opening in the wall so that the lamp's rays may be shed into two or three rooms or compartments at the same time. This is said to answer all purpose where a moderate illumination is desired, such as in bed rooms or hallways. The openings into each room are protected by frosted or ribbed glass so that the privacy of any of the rooms served by the lamp may not be interfered with and shutters are provided in order that the light may be excluded from any of the rooms when it is so desired.

Focussing and Finding Device for Cameras.—Carl E. Akeley of New York, who is responsible for a number of important improvements in cameras for scientific research, has recently secured a patent on a combined finding and focussing device in which an oblique reflector is adapted to be brought into axial alinement with either the photographic lens or the finding lens, as desired. This invention simplifies the camera construction by eliminating the ground glass and the necessity for consulting it in order to get the picture in accurate focus. Mr. Akeley's improvement is designed particularly as a feature of a new moving picture camera for scientific work, which he has devised.

New Engine for Dentists.—The terror-inspiring aspect of the engine which is part of the equipment of the dentist's office has been removed by the invention of a new engine of very much smaller proportions and unobjectionable appearance. The new engine is cylindrical in shape, 1¼ inches in diameter and of not much greater length. The tool to be used is mounted on the end of the new engine. A flexible cord connects it with the source of current, and its operation is controlled by a device placed on the floor in easy reach of the operator's foot. It is capable of four speeds and reverse, making from 600 to 2,800 revolutions per minute. Its action being direct, with a total absence of gears, the engine runs almost noiselessly and with very little vibration.

Compass That Indicates the Time.—By a slight modification in the ordinary pocket compass it has been transformed into a very practical timepiece for indicating the hour by the shadow of the sun. In addition to the usual "points," there is a graduated hour scale with the two twelves at the North and South. The crystal by which the magnetic needle is protected has a line etched across it through the center and it is mounted in a bezel which permits of the glass being rotatably moved. Knowing the variation of the compass, an adjustment of the glass is made to overcome it, the etched line forming an angle with the North and South line corresponding with the variation. The instrument being held horizontally and the etched line being directed against the sun, the time is indicated by the needle, the point of which overhangs the graduated hour scale.



Young naval recruits learning the rudiments of wig-wag signalling

At the Newport naval training station. Physical training exercises

Our Navy as a Schoolhouse

Success of the New System in the First Year of Its Operation

By E. K. Roden

UNTIL quite recently a man's advancement in the Navy depended entirely upon himself. If he was capable and in earnest to improve himself, the greater his success as measured by rank and pay. If on the other hand he showed disinclination or incapacity to advance he would quit the service for good at the end of his four-year enlistment. Now a new order of things prevails in the Navy. An enlisted man must study, not only subjects pertaining to his duties aboard ship, but also if need be the "Three R's."

Under the new Navy regulations, academic instruction is compulsory for all enlisted men, in the first two years of their first enlistment, who are found deficient in common school branches as determined at the training stations or upon enlistment, or by examination. The only exception to this rule are men who have served in the Navy for more than two years and those whose educational attainments are such as to meet the requirements prescribed by the Navy Department. But all men may study and receive academic instruction if they so choose even though they may be exempt by existing rules.

The new regulations were put into effect January 1st, 1914, the purpose being to supply the need for academic education and also to provide systematic means by which all enlisted men and warrant officers may receive the assistance and encouragement in technical branches necessary to fit them for promotion in the Navy, or which will better prepare them for civil trades at the end of their enlistment. Under this plan the ship's routine includes a period each day set aside for instruction during which no work is required except in cases of emergency or necessity, the instruction being conducted by officers of the ship assigned for this duty.

An evidence of the interest the enlisted men are taking in the new system is shown by a recent report received by the Navy Department from the Asiatic fleet giving the number of men on each ship receiving instruction. The list follows:

	Compulsory	Voluntary
U. S. Destroyer Chauncey.	13	11
U. S. Tug Wompatuck....	—	25 (all)
U. S. Monitor Monadnock.	5	8
U. S. Gunboat Samar.....	5	3
U. S. Gunboat Quiros.....	0	11
U. S. Gunboat Villalobos..	0	12
U. S. Gunboat Elcano.................	8	2
U. S. Gunboat Helena.................	30	6
Submarine Flotilla....................	41	28
U. S. Destroyer Dale.................	7	25
U. S. Cruiser Saratoga................	125	52
U. S. Cruiser Cincinnati...............	73	75
Total	307	258

The most striking feature of the report is the large number of men exempt from compulsory study who participate in classwork of their own volition. Other divisions of the fleet show the same percentage of scholars in their crews.

The result of the system in the first year of its operation is evidenced by the promotion of enlisted men to warrant rank. During 1914 no less than 77 men were appointed warrant officers as follows: boatswains, 18; gunners, 20; machinists, 27; carpenters, 11; pharmacists, 1. The figures for the past year are not yet available but the indications are they will greatly exceed those of 1914.

Not only are enlisted men given the opportunity to advance to warrant rank, but a chance is also accorded them to become commissioned officers by the new system. The act authorizing the appointment each year of 15 enlisted men of the Navy as midshipmen at the Naval Academy was passed June, 1914. Any enlisted man under 20 years of age and who has had one year's service in the Navy is eligible for the examination. In 1914 the candidates had only a little over one month's time in which to prepare for the examination which was held on August 3rd. One hundred and fifteen candidates were examined; five passed, three of them coming from the same ship, the U. S. S. "Maryland." In 1915 there were 55 candidates, ten of whom passed the mental examination. Of these, six have entered the Academy as midshipmen and four were ordered to the Naval Hospital, Washington, D. C., for treatment of physical defects in order that they be given every opportunity to qualify for appointment in October this year. The five who entered in 1914 are still at the Academy and have excellent records.

The names of the successful men and their former rating are given below:

1914

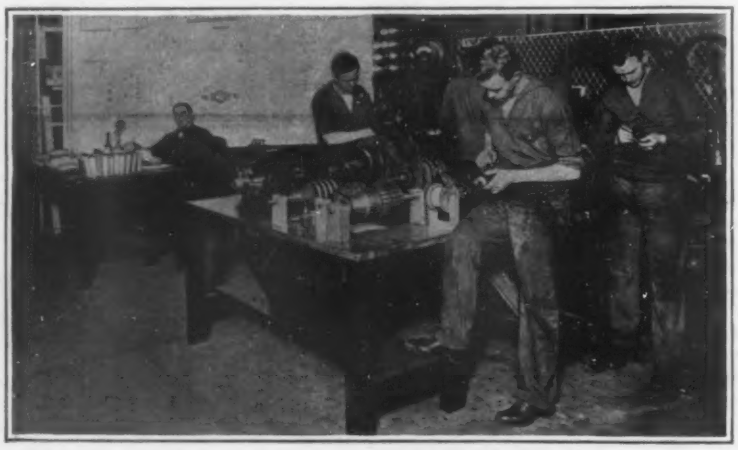
Name, rating and state:

W. Busk, Ordinary Seaman, Nebraska.
H. S. Corbett, Seaman, Massachusetts.
A. L. Hungate, Jr., Ordinary Seaman, Indiana.
J. W. Rowe, Musician, 2d Class, Wisconsin.
W. W. Warlick, Seaman, California.

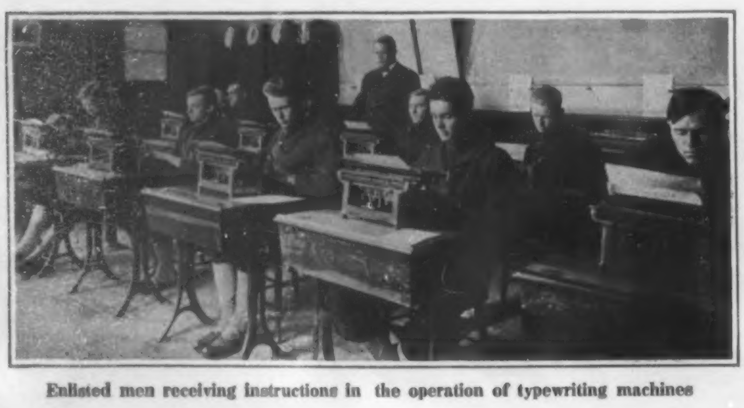
1915

J. G. Atkins, Seaman, Wisconsin.
T. O. Brandon, Seaman, Indiana.
B. F. Collins, Ordinary Seaman, Illinois.
W. B. Cooley, Electrician, 3d Class, California.

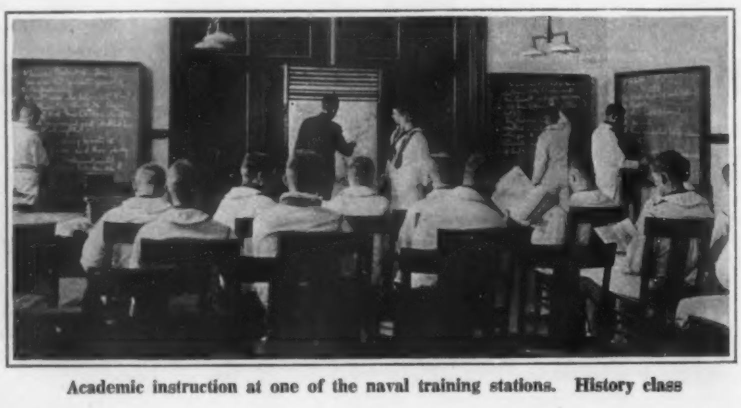
Bluejackets being taught the mysteries of wireless telegraphy. Here they are seen at code practice, taking down on paper the test messages



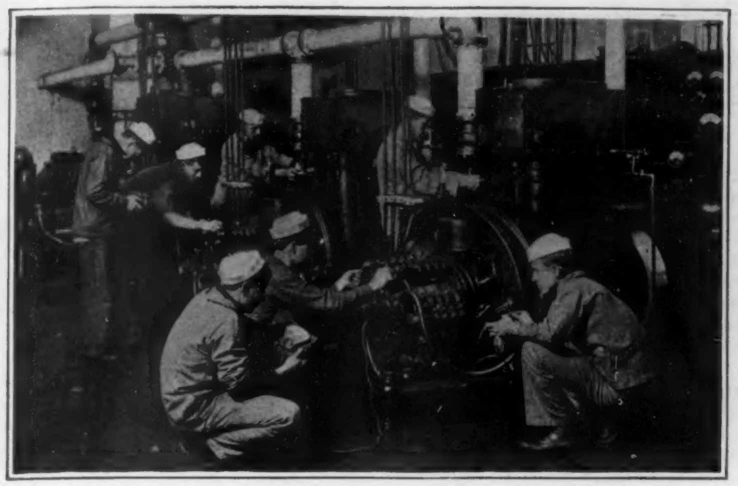
Practical lessons in the care and repair of electrical apparatus



Enlisted men receiving instructions in the operation of typewriting machines



Academic instruction at one of the naval training stations. History class



Practical instruction on the operation of electrical machinery

Developing enlisted men into practical machinists: Class for machinist mates

Roy E. Druet, Electrician, 3d Class, Louisiana.
H. M. Jackson, Ordinary Seaman, Virginia.
J. B. Noble, Seaman, Texas.
C. H. Schildhauer, Hospital Apprentice, Wisconsin.
S. L. Wells, Ordinary Seaman, Colorado.
H. S. Woodman, Hospital Apprentice, California.

In line with the general educational scheme afloat, academic studies now form an important part of the instruction at the several training stations where the facilities for this class of work are excellent. Another agency provided by the Government for the benefit of the men afloat, and one which especially distinguishes the new Navy from the old, is the library aboard ship. Ample funds have been provided for all needful purposes, and a generous supply of books is placed at the disposal of the service. Thus a battleship is allowed 500 books for its crew's library and 300 volumes for its ship's library—assuredly a liberal allowance; and with the privilege of exchanging old, unacceptable or obsolete books at frequent intervals for new works, this allowance of 800 volumes constitutes a valuable storehouse of knowledge and recreation for the ship's company.

Whatever success the new system will attain as a permanent feature of the navy, two things are certain: It makes the naval service more attractive and it gives to the young enlisted man with grit and ambition a chance to succeed equal to that of his compatriot at the Naval Academy; it will substitute for the careless, rollicking, and more or less disreputable seaman of former days, an entirely new type of man-of-war'sman—active, alert, intelligent and educated, respecting himself and respected by his officers, well-paid, well-fed, and well-clothed, surrounded by comforts of which the sea-faring man of a score or more years ago knew nothing, with the certainty of rapid advancement in rate and pay if he is faithful and industrious, and with a possibility of promotion to the rank of commissioned officer.

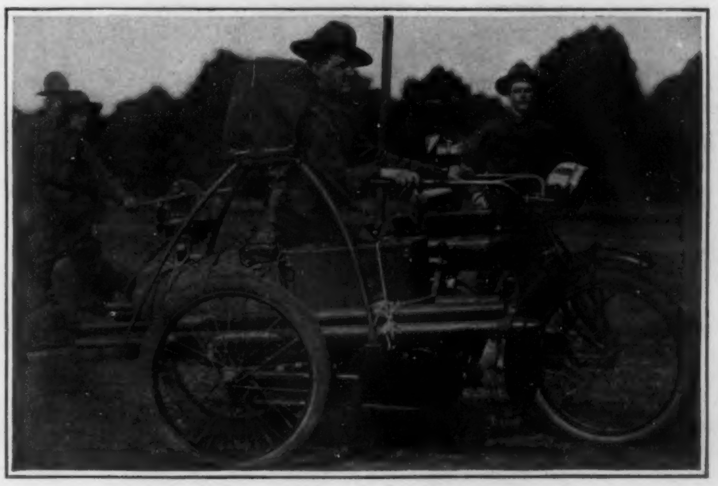
Motorcycle Radio Stations as a Factor in Military Operations

CORPORAL GREENHOW JOHNSTON, of Richmond, Va., organized a motorcycle squad of eight men for auxiliary service in the Signal Corps of the Virginia Volunteers on January 21st, 1915. It is reported that the military value of motorcycles has been significantly proven by the exploits of this volunteer organization, especially in connection with portable wireless stations, which have been carried with marked rapidity from point to point over roads little better than foot paths, and readily set up and operated.

The following is quoted from a report sent by Capt. F. S. Splatt, Type D Signal Corps, Virginia Volunteers, to the Adjutant General of Virginia, relative to the subject of the volunteer motorcycle squad:

"In accordance with the policy outlined by the commander of the company, this command assembled 8 A.M., November 7th, for mounted practice. Forty-five men and one officer reported. One wire cart, one wagon and two pack mules were used. The motorcycle squad recently organized in the company was used for the first time. The command left the armory 9 A.M., and proceeded to the state fair grounds in regular formation. One ration was carried.

Motorcycle squad and wireless apparatus of the Signal Corps, Virginia Volunteers



Standard wireless pack set of the United States Army, carried on a motorcycle side car

"Equation exercises were given for about two hours, followed by section drill of about one hour's duration. Wire lines were laid within the fair grounds; communication was excellent. One radio station was erected at Byrd Park, several miles away, and one at headquarters (fair grounds). Communication was instantaneous and perfect. The radio pack sets are a success in every way.

"I cannot speak too highly of the speed and efficiency of the motorcycle section; this branch of the work is really a side issue of signal corps work and has never been authorized by the War Department. I commend its adoption by the state forces, and ask that you recommend the same to the War Department. The great speed over the pack mules, and the ability to get over the ground almost as well as the pack mules are the good features.

"The expenses incident to the work by the motorcycle squad have been paid by the individual owners of these machines. The company commander approves that these owners should be reimbursed for fuel and wear and tear on the machines out of the funds allotted for practice drills.

"I consider the practice drill a success, a great help to the organization."

It may be of interest to add that the wireless sets used by the volunteer organization are of the standard United States Army pack type, equipped with a pole made in sections and a hand-driven generator. Practically no alterations are necessary in converting the standard motorcycle fitted with a side car into a motorcycle wireless plant.

The Current Supplement

THE leading article, *Evolution in Shipbuilding*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2095, for February 26th, 1916, is a résumé of the wonderful progress that has been made during the last century, and is of particular interest in view of the remarkable demand for marine transportation made necessary by current events. *Aerial Torpedoes* describes the small trench mortars, with their curious projectiles, which are being used extensively by all combatants in Europe, and it is, fully illustrated. *Some Noted Zoological Parks* describes and illustrates the gardens of the Royal Zoological and Acclimatisation Society of Victoria, in Melbourne. This is one of a series of articles that are appearing in the SUPPLEMENT. *School Spread of Contagious Diseases* discusses a subject of vital importance in every community, to which but scant attention has been given either by the authorities or by medical men. It should be read by everyone. *Explosives* contains interesting facts relating to the history of the most important material used in the war, and one that is daily becoming more important in domestic use for purposes of peace. *Temperature Inversions in Relation to Frosts* gives some methods of anticipating critical periods as related to crops, and is worthy of the attention of those engaged in agricultural pursuits. *A Metallographic Description of Some Ancient Peruvian Bronzes* is a study of archeological relics from a new point of view that may be of ultimate value in modern commercial processes. Among other articles of general interest in this issue are *The Relative Stimulating Efficiency of Spectral Colors for Lower Organisms; Hints on Judging Diamonds* and *The Early Days of the Railroad.*

Motorboat Submarine Destroyers for U. S. Navy

PLANS for two types of motorboat submarine destroyers, designed to have a speed of at least 41 miles an hour, have been submitted to the Navy Department. Models will be constructed at once at the Washington Navy Yard and tested to determine whether the engines the designers propose to install will develop power for the required high speed.

The Department recently obtained bids from several boat builders on craft of this type, but there was such a wide variation in the power proposed for boats of approximately the same size and lines that a test was decided on to determine just how much power would be required.

The boats are primarily intended to be carried aboard capital ships, two to a battle cruiser, and to form an inner protective screen against submarines when a fleet or squadron is at anchor or cruising slowly on station at sea. From the experiments with these craft, however, a standard type of motorboat for submarine patrol duty along the coasts and off harbor entrances in time of war probably will be developed.

Industrial Preparedness for Peace

The Possibility of a Permanent Dyestuff Industry

By Wallace P. Cohoe

HOW are colors extracted from coal tar? This question is frequently asked by the uninitiated. It is sometimes asked by those who should know better. One popular conception seems to be that colors may be produced by putting coal tar into one end of a piece of machinery—the wheels turn, and the colors come out at the other end. By suitable arrangement of levers the machine may be made to turn out reds, blues, yellows and all combinations of them.

About next Easter, ladies will find that American ingenuity has not yet been able to produce any such machine. Certain colors are now practically out of the market. Others are fast being exhausted. One mill has thousands of yards waiting to be dyed green. Manufacturers are asking where they are to obtain dyes when the present stock runs out.

The story of how one firm began to answer the question of shortage may be interesting. This firm has been for some years successfully engaged in the manufacture of hosiery. It is located near Chicago. One extensive line of hosiery consists of heavy cotton stockings which are dyed black. These goods meet a general demand and are sold everywhere. It is a popular line. The dye used must be fast to wear, fast to light, and fast to soap and water. To get this fast black, aniline is used as the basis of the color.

Some months ago, my friends were confronted with a serious problem. Aniline could only be obtained in limited quantities and at exorbitant prices. Black dyes are very heavy, that is to say, a large amount of coloring matter must be used on a pound of goods to produce a good shade. Aniline, which before the war had sold around ten cents a pound was costing as high as one dollar and seventy-five cents per pound. How could a hosiery manufacturer continue a popular line under such a set of conditions?

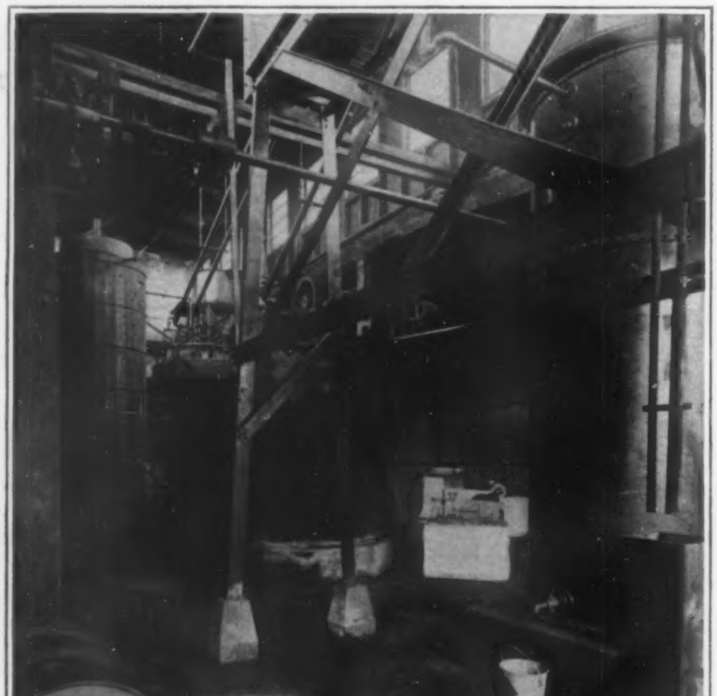
Fortunately these people had resource and courage. They decided that they would make their own aniline. Many wise men, particularly those with vested interests in dyes, very solemnly wagged their heads. It was folly for a knitting mill to make aniline colors. My friends were not deterred, however, by this head wagging. They decided to back their own judgment with their own money. They had a plant designed. It was ordered. Raw materials were bought. The plant was erected and is now turning out a ton of aniline each day. When more apparatus, now on order, shall have arrived they will be making two tons of aniline each day.

As some readers of the SCIENTIFIC AMERICAN may not be familiar with the process of making aniline, I will briefly outline it. The raw materials consist of benzol, sulfuric acid, nitric acid, hydrochloric acid, and iron turnings. Benzol is a light colorless liquid produced when coal is distilled either in gas retorts or in coke ovens. The other materials do not need any description as everyone is familiar with them.

The first operation consists in treating benzol with a mixture in proper proportions of sulfuric and nitric acids. The nitric acid attacks the benzol and there is produced a yellow, heavy, oily, liquid known as nitrobenzol. This substance has a peculiar odor and on this account it is used to give a perfume to shoe polishes and greases. It is sometimes called oil of myrbane. The manufacture of nitro-benzol is conducted in a large iron vessel provided with cooling arrangements and a stirrer. Into this vessel a charge of benzol is run. A usual charge in full sized plants is 500 gallons. Into this benzol with constant stirring is run a fine stream of the mixed acids. If the proper conditions have been maintained, shortly after all the necessary acid has been added, all the benzol will have been converted into nitro-benzol. The acid and the nitrobenzol are separated by gravity, the acid drawn off, and the nitro-benzol is washed and put into storage ready for the next operation.

The next operation is called reduction. The reducer is a heavy iron vessel provided with a central vertical shaft to which is fastened a heavy rake. This rake is designed to agitate the contents of the vessel. It runs as near to the bottom as possible. Hot water is introduced into the vessel, the necessary amount of hydrochloric acid and some nitro-benzol are added. Cast iron turnings are now slowly fed into the vessel from a funnel at the top. When properly managed, the chemical action starts at once. Iron must not be added too rapidly but only so fast as to maintain a temperature near the boiling point. Gradually the full quantities of iron and nitro-benzol are added. This operation requires about 12 hours. Shortly after the last iron is added the operation is complete. Steam is turned on and the aniline distilled and condensed. The crude aniline thus produced is usually but not always purified by distillation. In the plant referred to above, the reducers have a capacity of 1,800 gallons. This size permits a working charge of 2,500 pounds of nitrobenzol, producing upward of 1,800 pounds of aniline.

AMERICANS have a reputation for ingenuity and resourcefulness. Now we are being put to the test. Without the slightest warning we find ourselves cut off from certain imports that are vital to our manufactures. What are we going to do? Here is the answer of one intrepid firm. It is engaged in the manufacture of hosiery. Suddenly it was confronted with a shortage of black dye—a dye that must be proof against wear, light and soap. Unable to buy the dye the firm launched into the manufacture of its own coloring materials. It is an inspiring story; one of many instances of American enterprise, showing that we can make good when put to the test.—EDITOR.



Dye plant built by a hosiery company

Thus, starting with benzol extracted from coal tar by nitration and subsequent reduction, aniline is produced in these quantities daily. But aniline is not in itself a dye. By itself alone it will not impart a color to a fabric. Aniline belongs to a large class of substances which color makers call intermediates. From these intermediates, the colors themselves are produced. It is seen then that in the color industry there are essentially three general classes of substance. We have first the crudes of which benzol, toluol, naphthalene and anthracene are examples. From the crudes, intermediates are made; of this class, aniline, toluidine, benzidine, phenylene diamine, salicylic acid, benzaldehyde, the naphthols and alizarene are a few examples of the many. By the chemical treatment of the intermediates or by the chemical combination of two or more intermediates are the hundreds of dyes produced.

The problem of the color manufacturer in building up the complex chemical structures called dyes may be roughly compared to the problem of building a physical structure. Suppose one wishes to build an ordinary house, consisting of bricks, lumber, nails, sand and lime. All these materials are necessary but they in their turn must first be made from crude materials. The bricks are formed from clay and burned. Trees are cut in the forest, sawn into lumber, seasoned and dressed. Iron ore is smelted, converted, rolled into bars, drawn into iron and made into nails. Limestone is quarried and burned. Thus the crude materials are made into manufactured materials and by using these latter the builder produces a structure. So in the chemical field from the crudes are manufactured the intermediate manufactured products. The chemist takes these intermediates and by various methods builds the chemical structure which we call a dye.

It will be seen then that the manufacture of dyes is something more than the mere extraction of colors from coal tar.

I have endeavored to outline above some of the general features of the color industry and to illustrate by a concrete case an attempt on the part of an American industry to solve one of its serious problems.

Just here, we may well ask two questions. First: Do we want a permanent dyestuff industry in America? Second: Can we have a permanent dyestuff industry?

Some years ago, the leading textile interests did not want a permanent dyestuff industry in America; at least, not if such an industry required tariff protection. To-day these same interests after a most unhappy experience of several months' duration have said never again do we want this experience. Let us have a permanent dyestuff industry here in America. We wish to be industrially as independent in the matter of dyestuffs as we are in the matter of cotton or steel.

This brings us then to the second question. Can we have a permanent dyestuff industry in America?

Looking at the physical side of the question, the amount and availability of raw materials naturally come up first. These raw materials naturally fall into two classes. First, there are the coal-tar derivatives which go into the manufacture of crudes; and in the second place, we have the heavy chemicals which are necessary in the working up of the above.

With respect to the coal-tar derivatives, it may be said that this country has a supply of raw materials quite large enough and to spare for all its present and future needs as far as the latter can be forecasted to-day. Coal-tar derivatives may be obtained wherever coal gas or coke is made in by-product ovens. Until recently the lighter distillates from coke ovens were burned, but the demand for benzol and toluol to be made into explosives became so great that many recovery plants were installed. To-day, thousands of gallons of benzol per day are recovered at individual plants where previously they were wasted. Generally speaking, it may be said that as long as we have a steel industry in this country just so long shall we have the coal-tar derivatives necessary for a dyestuff industry.

In the second place, we ask whether there is a sufficient supply of the heavy chemicals necessary. Most important among these chemicals are sulfuric acid, nitric acid, hydrochloric acid, caustic soda, soda ash and chlorine. The answer to the question is most emphatically in the affirmative. In fact, we are making them to-day and they are being used in the manufacture of explosives. When the vast quantities of these materials now being made daily shall be released for use for other purposes, we shall have an abundance of heavy chemicals for a dyestuff industry.

This leads, however, to a present difficulty. Many people are willing to start upon the manufacture of colors at once. When they endeavor to secure the chemicals necessary, however, they are halted by the extremely high prices asked for them. This is only a temporary condition, of course, but it is one reason why America has not made more of a start towards a dyestuff industry. When the war is over and munition contracts are filled, then supplies of chemicals will be easy and prices will drop first to normal and then possibly to levels lower than before.

(*Concluded on page 228*)

General Staff Maps

Importance of Military Maps in Modern Warfare

By Lieut. Guido von Horvath

In order to give our readers an insight into the modern military tactics and strategy, we have arranged with Guido von Horvath, a former lieutenant of the Austrian-Hungarian Army, to conduct a War Game series in the columns of the Scientific American. *The subject will be introduced and carried out without the use of technical terms, except where unavoidable, and every effort will be made to present the matter so clearly that it can be readily understood by the lay reader. The series will start with operations on a small scale working up the units of all three sections of the army combined in a division.*

The author of the series has had a very interesting career. He became lieutenant in 1894, and on account of his talent as an artist, was a year later commanded to the Military Geographical Institute of Vienna, a branch of the General Staff. Two years' special training ended with an interesting commission as Honorary Ordnance Officer to His Majesty Musaffer Edin of Persia, whom the lieutenant accompanied to the Persian capital, Teheran.

Upon von Horvath's return to his own country he was promoted to first lieutenant and served in the famous Nadasdy Hussars. He partook in the international policing service of the Island of Crete.

In peace-time service he was wounded by a crazed soldier which disabled him for active service and brought him the medal of bravery. Under the climatic conditions of his own country he had no hope of recovery; he accepted a commission in Brazil and there had active service of topographical and military character.

After almost two years' struggle in the Amazon country, he decided that the tropics did not agree with him and, ill with yellow fever and just recovering from another wound, he returned to his home country, thence he came to the United States.

Lieut. von Harvath has followed the preparedness question which is now agitating this country with great interest, and has offered his services to the United States.

The present article is an introduction to the War Game series. It explains the importance of true maps in warfare, and shows what a wealth of information is to be found in a modern military map. In a succeeding issue, Lieut. von Horvath will present the first of the War Game series.—Editor.

There is nothing more important in the conducting of modern warfare than absolutely true military maps.

In the eyes of the public a map generally represents a somewhat uncertain guide, of mysterious character, therefore the public does not realize the momentous services rendered by war or general staff maps.

In the war of 1870-71, France was a great deal handicapped by the lack of reliable maps. They possessed maps of Germany made by the German general staff, but they never had occasion to use them.

All the warring European nations are provided with war maps, with the exception of parts of the Balkans. These maps are not handled as secret documents—civilians can buy them without any trouble—but to read them is another matter. To be able to understand them thoroughly, one must have a special training in every detail. Every officer, commissioned or non-commissioned, is taught the use, the reading and the making of these maps. Every tactical and a great many strategical operations are planned on these maps. Besides ranges for artillery of all calibers, the movements of troops, the selection of the battle grounds, the provisioning, the quartering, the disposing of the wounded, in fact, almost every military plan is based on these maps. The immense scope of modern tactical operations could not be controlled by the Centralized General Staff without them.

The providing for military maps of absolute accuracy is an institution of a century's growth. It was first introduced in Bavaria, and from there it was adopted in the early sixties by Prussia and also Austria-Hungary.

The Germans have developed their maps as well as every other detail of their wonderful military machine, to a marvelous extent, but nevertheless, those who are familiar with this subject will have to admit that the Austro-Hungarian General Staff maps are in many respects even superior to the German.

Nothing can show the importance and the condensed information contained on such a map better than a study of the accompanying fragment from an Austro-Hungarian style map.

The enlarged section on a regulation 1 to 75,000 map occupies a square inch. The 1 centimeter on the map equals 75,000 centimeters or 750 meters on the terrain.

An officer trained in the reading of this map has the following positive information at his disposal:

From N to S a regulation single track railroad runs through the section. From N to S the track is on an embankment, which is important as a line of defense. The bridges, three in number, are of steel construction. There is a siding at the village where the depot is located. The depot is outfitted with telegraph and telephone connections. West from this railroad in the upper corner, a hill 27 meters high is marked with a triangulation point. Right behind this is a group of large trees, while on the sloping western side a highway comes toward the three arched stone understructure bridge, with wooden railing, which spans the creek. This road turns parallel with the railroad and enters the village. The road is wide enough to permit the passage of double rows of vehicles both ways. It retains its width throughout the village.

The village has a population of 327 people, a mail and mail coach service. The Catholic church has one spire and is located in the cemetery, which has stone walls surrounding it. The village has plenty of trees and vegetable gardens. The houses are built of masonry and the village has a good defensive front toward the west.

The creek in the N. E. corner is lined with trees and is rather swampy. The island is wooded with a bushy sort of growth, also the groups east are rather thick. The creek has tendencies to overflow, is bordered with grazing lands and in places with rushes. It is difficult to ford. A single track road not always passable crosses it west from the church yard, there is a temporary bridge across, that is not passable by artillery and heavy train. In the S. W. corner on a country road is a well kept bridge of wooden understructure with planks and railing. From this bridge the country road goes with a short branch into the village and the other branch goes directly east, crosses the highway and railroad at even level, then turns north. South from this road is a stretch of difficult swampy ground with a creek, the source of which is right under the top of hill 33. There is a stone quarry in its vicinity and a road not always passable leads to it. This creek runs through a ravine. Its water is potable. The hill is covered with a forest of tall oak on the S. E. side and is bushy on the farthest northern point, mingling with pines. The roads forking at almost right angle are first class country roads. In this fork is a farm and vineyard, etc.

There is no use in going further in order to convince anyone that with those cleverly devised signs, which in many cases are pliable for finer expressions, one can show on a square inch much more and at a glance, to those who can read this language, than with several lengthy treatises.

With this information, are given the absolutely correct distances. Of course these distances are air-line figures, which are all that is needed for the artillery and infantry fire range, but here another question arises. The unevenness of the terrain, the hills, mountains, valleys and other hindrances, which are sure to influence the movements of the troop, must be considered and must be known just as exactly as the air-lines for the range.

The system which gives the best service to express the unevenness of the terrain was invented by the Austro-Hungarian Colonel Lehman, and the scale he devised is called the Lehman scale. To make this question clear, it is best to examine the diagram, showing the plan and the section of a hill.

Any unevenness of the ground amounting to more than ten feet is recorded through this system. The theory is to imagine that every hill or mountain is built up of slices and where those slices come to the surface, there is a visible line on the map which is termed a contour line. In the above diagram this is shown very clearly.

After a little closer observation, the question looms up: What is the meaning of the closeness of the contour lines, or the larger distances between the same? The answer is very simple. In the first case the fall of the ground is more rapid than in the other, where the contour lines are farther apart. The wider the contours the easier the slope.

All this is clearly expressed by the contour lines, but what happens to be between these lines is not considered when only contours are used. Whether the

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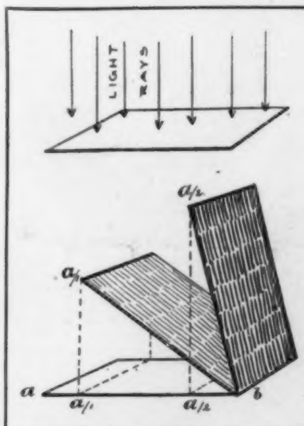


Fig. 1. How sloping ground is shown by shading

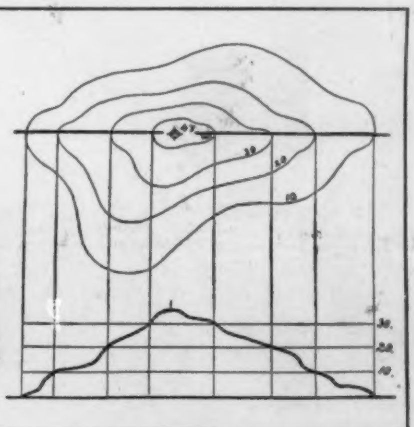
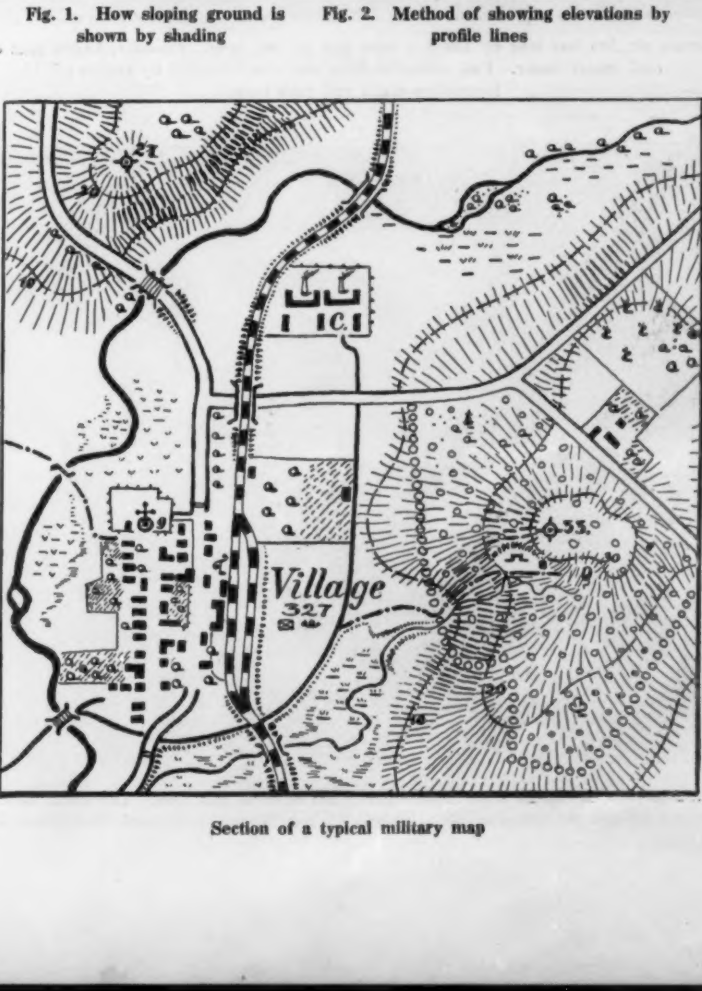


Fig. 2. Method of showing elevations by profile lines



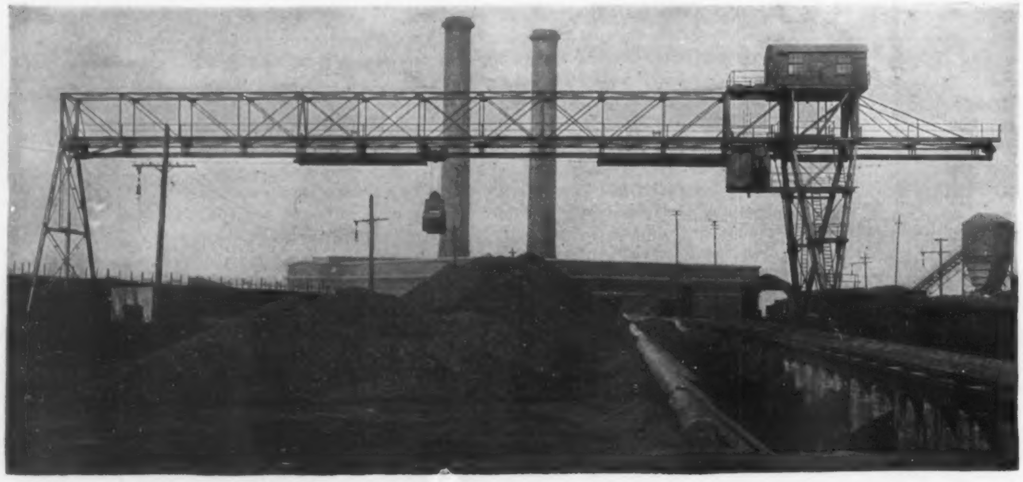
Section of a typical military map

Preparing to Meet a Coal Shortage

Problems of Storing Coal

By C. E. Lesher, of the United States Geological Survey

ON the first of next April all wage agreements between the coal operators and the miners' union, in both the anthracite and soft-coal fields, will expire. The agreements now in effect were made in the bituminous fields in 1914 for two years, and in the anthracite fields in 1912 for four years. No one is now in position to state whether or not there will be a shut-down at the mines before the new agreements are reached, but as long as there is a possibility of such a contingency, consumers of coal for self-protection should prepare to meet it. There is a small stock of anthracite in the hands of the "hard-coal" railroads upon which the retailer and small consumer can depend, but no stored supply of soft coal exists against which the ordinary consumer can draw. The railroads and their large users of coal have already begun storing, and there are now between 3,000,000 and 5,000,000 tons of soft coal in stock piles, mostly of an emergency character.



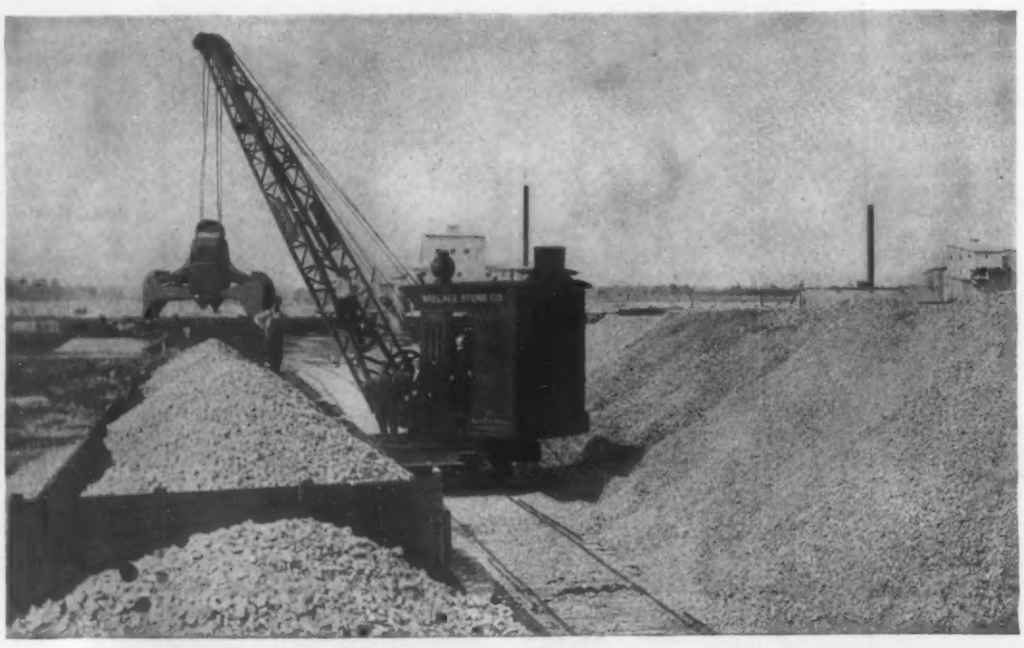
A type of coal storage and handling apparatus suitable for industrial plants, locomotive coaling stations, etc., in quantities from 10,000 to 20,000 tons

Although the miners' union has expressed a willingness to continue work at the mines after April 1st, during the progress of negotiations, the experience of the companies in past years indicates that time will be lost through temporary suspensions and that there is always the possibility of deadlock and a strike in some portion of the coal fields. It is just this possibility—cessation of mining operations through suspension or strike, with resultant lack of coal supply—that is beginning to cause the user of coal, the "innocent bystander," to ponder seriously over what he will do to meet the contingency. The coal industry, particularly the bituminous-coal industry, is a hand-to-mouth affair. Probably the greater part of the soft coal mined is sold or contracted for before it is touched with pick and shovel, and most of it is used almost as soon as it is received. In ordinary times the only supply of coal above ground is that in railroad cars in transit, and this quantity, when the demand is as strong as it has been for the past several months, will suffice the consumers' needs for but very few days, at most. For the railroads, factories, mills, smelters, and thousands and thousands of small users of coal, the shutting off of even a portion of the supply for so short a time as a few weeks or months is a serious matter and one that calls for foresight and preparation.

Concrete pit, 300 feet long by 100 feet wide and 28 feet deep. Capacity, 13,000 tons of coal, under water. Coal unloaded from cars and reloaded by means of locomotive crane and grab bucket

Coal-mine operators and owners are not prepared to store coal. Shipping mines are all equipped to dump coal directly from mine cars through the tipple into railroad cars, and where operators (as in southern Illinois, during the past year) have undertaken to store part of their product, they have been under the necessity of unloading coal from railroad cars onto the ground and reloading as the demand for the coal arises. A great many coal mines in this country, particularly in the eastern or Appalachian fields, are located in narrow valleys and have no ground space close by on which satisfactory storage facilities can be provided. This disadvantage might be largely overcome, however, if the mine operators were able and willing to undertake storage on a large scale. The greatest difficulty arises from the cost. The average coal-mining operation is conducted on such a narrow margin of profit that, all things considered, the individual producer is not able financially to undertake the storage of his product, but even if the producer were in position to keep on hand a large supply of coal, it should not be stored at the mine. The logical place for storage is at or near the point of consumption.

The carriers of coal—the railroads—can not be expected, of course, to store coal except for their own use. In the anthracite region the comparative smallness of the field and the close relations between the operators and the railroads do permit storage in an admirable manner, of the excess of production over consumption. During the last summer the domestic consumer of anthracite did not, to the extent of former years, take advantage of reduced summer prices and lay in his winter supply of fuel, and the result was that to keep the mines going at anything like the normal rate, the anthracite operators were obliged to turn their product over to the railroads for storage. It has been estimated that at the first of this year the quantity of anthracite in the storage piles of the hard-coal roads was not less than 5,000,000 tons. It is maintained that this is the natural result of slack conditions, last winter and last summer, and has not been done to meet the possible contingency of a strike, but it is comforting to know that some coal is available, in the event that there should be a prolonged shut-down of the anthracite mines. It should be pointed out that this quantity is small and that it has not been divulged just what sizes are in storage.



Temporary storage piles of coal to meet an emergency are often of this kind. The small locomotive crane and grab bucket unloads the cars and piles the coal. When the coal is wanted, the process is reversed

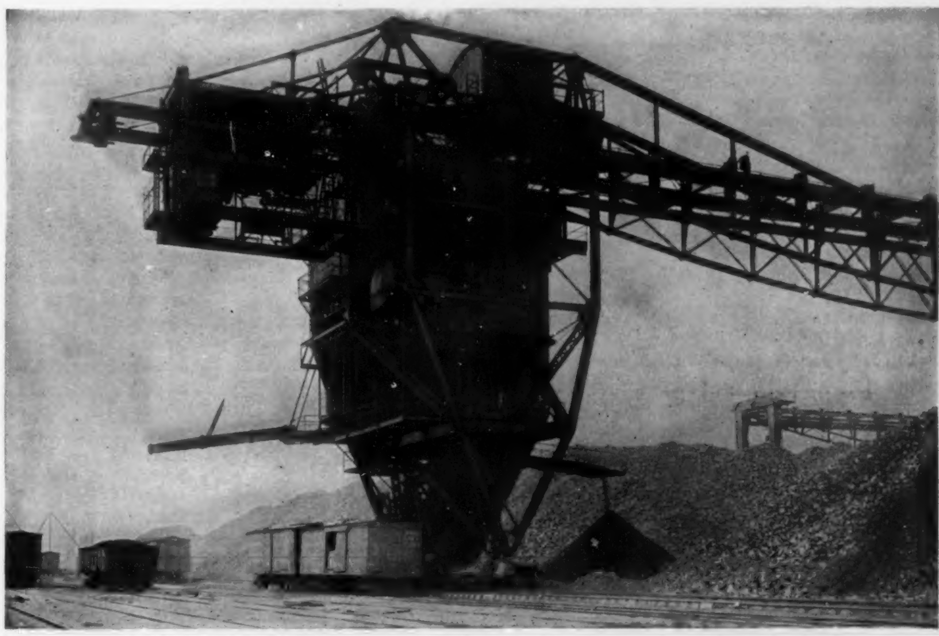
If the stock piles consist of the larger or domestic sizes, the supply will last for several weeks, or perhaps longer, depending, of course, upon the demand which, in turn, depends upon the weather, but if the stock consists mainly of the smaller or steam sizes, the domestic users will be little benefited. In view of this uncertainty, it is clear that the best way for the consumer and the retailer to prevent a shortage is, before the first of April, to store the coal that he will need.

No such stock of soft coal is available. In the event of a suspension of mining in the unionized fields, notably those in Pennsylvania, Ohio, Illinois, Indiana, and the southwestern states, those dependent upon coal from those fields must turn for their supply either to the non-union fields or to their stock piles. Even were the non-union fields (in West Virginia, Virginia, Kentucky, Alabama, and the far west) able to produce sufficient coal to meet the demand—which they are not—the railroads tributary would not be able to move the coal to all sections because of lack of cars and locomotives. It is true that a great quantity of both soft and hard coal is in storage at the upper end of the Great Lakes, at Duluth and Superior, and adjacent points, a quantity probably between 6,000,000 and 7,000,000 tons, but this coal is regularly stocked at those points and is required to supply the normal consumption in the northwest, that is, from Minnesota, west to Nebraska.

For his own protection the consumer, large or small, should, then, have a stock of coal with which to tide over times of shortage, whether due to labor troubles or labor shortage at the mines, or to inability of the railroads to deliver because of lack of equipment, or by reason of severe weather conditions.

The economical storage of coal, even on a comparatively small scale, except, perhaps, in dwellings, requires a certain amount of equipment and involves a financial outlay. The particular method to be adopted depends to a certain extent upon the kind of coal. Anthracite does not take fire from spontaneous combustion and can, therefore, be heaped to any height desired, and it does not crumble or break up seriously in handling, as does most bituminous coal. The conical-pile method in general use in the hard-coal region is probably the cheapest system of open-air storage. On the upper Great Lakes docks both anthracite and bituminous are stored in quantity every winter, in long, narrow heaps. The coal is put into these heaps and taken from them by means of clam-shell buckets suspended from overhead cranes, which, in turn, form a part of traveling bridges of the types shown in the accompanying illustrations. The coal for the Great Lakes trade is delivered to the lower lake ports, such as Buffalo, Erie, and Cleveland, by rail from Ohio, Pennsylvania, West Virginia, and eastern Kentucky. It is dumped into cargo boats and transported to the upper end of the lakes, either to Chicago and Milwaukee, or Duluth and Superior. This movement takes place, of course, in the summer, during the open season of navigation. From the boat the coal goes into storage piles to wait the winter demand in the northwest, to supply which another shipment by rail is necessary. Before being put into cars for the last time the soft coal is carefully screened and sized to eliminate the fines caused by numerous rehandlings.

Temporary storage yard at Savannah, Ga. Coal is transferred from the cars at the left by means of a belt conveyor and dumped directly into boats



Rescreening apparatus for coal

The coal is picked up from the stock piles at the right, in a grab bucket which may be seen on the near side, about half-way up the machine. By means of elevators and screens the fine coal and lumps are separated, the fine or slack coal being either loaded into flat cars or piled to one side, as in the picture, and the lump coal loaded in cars for shipment

Vast quantity of coal at Lambert's Point yards of the Norfolk and Western Railroad awaiting the arrival of coal vessels

The simplest, and incidentally the most expensive way of storing coal is in railroad cars. The accompanying illustration shows Lambert's Point Pier yards of the Norfolk & Western Railroad, at Norfolk, Va., well stocked with coal. This coal, which is in the yards awaiting the arrival of vessels into which it will be dumped over the unloading piers, is really in transit and can not properly be called "storage coal."

One of the commonest methods of building up storage is by means of dumping from temporary wooden trestles. Long, narrow piles are thus made, varying from a few feet to 20 or 30 feet in height. The coal is recovered from these storage heaps either by hand-shoveling or by mechanical means, such as steam shovels, grab buckets, or locomotive cranes. This is usually termed "emergency storage," and is frequently resorted to by the railroads. It is also in common use at retail yards and by small industrial plants. A large percentage of coal that is now, or will be laid by to insure a supply, next April, will be handled in this way. The first cost of such a plant is small, but the operating cost is high, ranging (according to figures compiled by the International Railway Fuel Association) from 10 to 30 cents, or over, per ton. Better laid out and equipped plants, such as shown in the accompanying illustrations, the first cost of which, according to the same authority, may vary from less than a dollar to several dollars per ton of storage capacity, are said to unload and load coal in quantity for five cents, or less, per ton. Interest and depreciation on the plant, and interest on the money invested in the stored coal are to be added to the operating costs, of course, to arrive at the total cost of storage. The figures will vary greatly with conditions, but at most the cost can be considerel a cheap insurance against shortage. Large corporations, such as the companies which

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Strategic Moves of the War, February 18th, 1916

By Our Military Expert

About everything that has been written regarding the strategic movements of the war has been solely based on the assumption that the allied lines—and properly, so far—have existed purely on the defensive; the viewpoint of the observer has been of this character and, in all probability, will so continue for some time, or until such time as developments permit a shift of activity to within the territory of Teutonia, if it ever comes.

Examination of the map of the territory before and behind the western line suggests very strongly that Germany's ideas as to her military integrity were concerned solely with the offensive; the location of fortified points is significant, for there exists no such chain of permanent fortifications as France has been compelled to build, but instead, simply enormous intrenched camps covered by strong works, behind which an army of invasion may mobilize and from which it may thrust.

The location of the contending lines to-day shows clearly how the first thrust was delivered—a gigantic pivot on Metz, to chop down through Luxemburg, Belgium and northern France, directly against the heart of the land, Paris. Below Metz, now covered by the famous Verdun-St. Mihiel-Pont à Mousson salient, the line practically parallels the frontier between France, Lorraine and Alsace without much sway one way or another. And the natural geographical frontier that Germany secured as a fruit of the Franco-German war has stood her in good stead. It is a fact that there are no permanent defenses of forts along the line of the Vosges, not even at the passes, the reliance of the German General Staff having been placed so securely upon assumption of the offensive that the natural strength of the mountain was considered sufficient for mere holding purposes.

The opposing lines, of course, front each other in this section as immovably as on the lines farther north, yet no great offensive in the section between the great salient and Belfort has been attempted by Germany, for she is merely holding on there.

Germany's real line of defense lies along the Rhine, which in the southern section is closer to the Entente lines than at any other point. The great fortresses of Metz and Strassburg cover the flanks of the lower sector of defense, and the way for a speedy shift of forces has been prepared by the construction of railway lines on both sides of the Rhine; and it is further backed by the inhospitality to invasion of the Schwarzwald, the Black Forest section, with its forbidding terrain.

Behind Metz and Strassburg are the great railroads for concentration and supply of field forces.

It is not inconceivable that the fortunes of war may so change that strategic necessity, such as the crushing in one or both sides of the salient formed by the northern part of the line, or the necessity for shortening the line through a falling off of man-power, may some time dictate the wisdom of a general Teutonic retirement to the Rhine. The possibility now seems remote—but it is by no means out of the question. But if this is ever done the war will seem to have started all over again, with Germany intrenched on a line shortened by something like 175 miles at a saving of between five hundred thousand and a million men, with the great river itself as a definite barrier to further allied advance, one that must be forced at a tremendous cost, and a line that is secured by fortified points, with the most monumental defenses that military science has been able to devise.

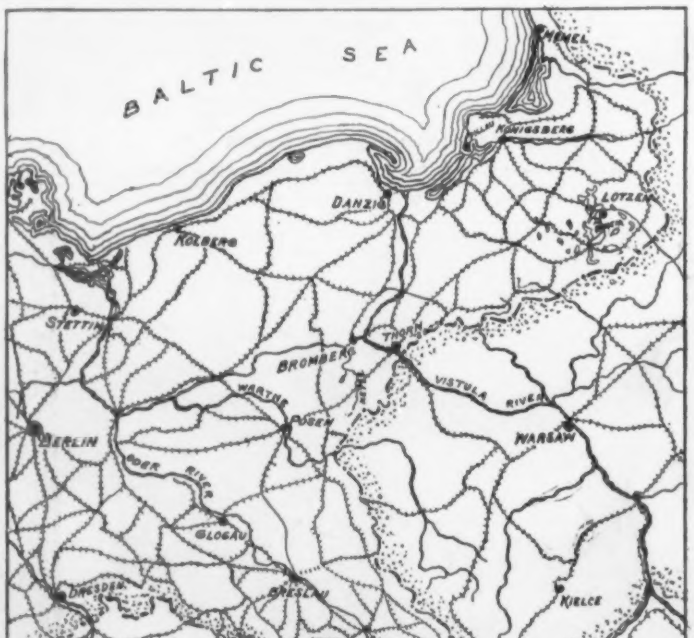
These powerful places begin at Strassburg, extend through Mayence, Coblenz and Cologne, and are supplemented here and there by lesser works of strength. These points are examples of fortified camps, as Germany depends upon the mobility of her forces for real defense instead of mere fortifications, which to her are but points of support. Neu Breisach, Rastatt, Bitsch and Diedenhofen, though, are fortresses which find their greatest utility as barriers on inviting roadways.

The Rhine fortifications are each located at strategic points, on or near rivers which they control. Cologne is the key to Rhenish Prussia and the great railway system that radiates in all directions; Coblenz controls the confluence of the Moselle and the Rhine; Mayence covers the Main, while the lower fortresses guard a portion of Germany that is essential for the supply of munitions of war.

Both banks of the Rhine are equipped with military railways that extend from the Swiss frontier to that of Holland, with at least fifty lines of railway touching the eastern bank of the river, for supply and speedy disposition of men. In turn, this Rhine railway is backed by many others paralleling the front—and each one has been built with military utility overshadowing commercial use; the country has been developed commercially to fit the railway system, not the reverse.

Germany's defenses in the west

Cologne and the neutral territory of Holland cover the great gun works at Essen, which, in itself, is behind the barrier of the Rhine, necessitating exposure of a flank to attack from the interior of Germany should an enemy succeed in penetrating far enough to begin operations against this depot Krupp, for neutral Holland cannot be used as an avenue of advance.



Germany's defenses against Russian invasion

When the Russian "Steam Roller" was launched in the first days of the war, it seemed as though it should be a comparatively easy matter for a powerful force to strike through toward Berlin, for the Russian frontier seems to lie close to Berlin. But the geography of the country, of the frontier, is all in favor of the Kaiser, as an advance through the southern finger of eastern Germany, with a length of line which such a movement would demand, is instantly menaced on the flank by the northern extension of Germany, that section almost tipped by the lake region where von Hindenburg leaped upon the Russian hosts.

To begin with, the eastern frontier is merely an arbitrary one, unmarked by any natural features; the real frontier should be, for Russia's benefit, the line of the Vistula, from Danzig, through Thorn fortress, to Warsaw, then south to Przemysl and on to Czernowitz, along the Dniester. Should the result of the war permit, Russia would be a material gainer by exchanging that part of Poland west of Warsaw for the portion of East Prussia east of the Vistula; it might even be a handicap to her were she to merely take territory without insisting on the exchange.

So the Russian threat against Berlin is not nearly so great as might seem at first glance. This frontier is also defended. A tremendous intrenched camp lies at Danzig, covering, with its companion stronghold farther south, Thorn, the curtain of the Vistula, the intervening crossings of the river being held by powerful bridgeheads, with a system of railway communications existing as excellent as that on the other front, the railway crossings of the river guarded by the fortresses of Gaudenz and Dirschau.

Konigsberg, a powerful fortress at the mouth of the Pregle, supplemented by Memel and Pillau, extends protection to East Prussia. The fortress of Boyen, near Lotzen in the lake region, covers the eastern arm of Germany from an advance by the south, its defense amplified and strengthened by the character of the country, forbidding to an invader, yet easily susceptible of defense.

Farther south, the German line of defense is covered by miles of marshes that are only practicable to an invader when the rigors of winter have frozen every thing hard; in the gaps between such sections, fortresses bar the way. Bromberg backs up the defenses of Thorn and covers the railway leading across the Netze, while powerful Posen is astride the valley of the Warthe.

On the Oder, Glogau interposes between an invader and a tempting road to Berlin, while the intrenched camp of Neisse covers the flank.

But as ever, Germany's principal reliance is in her wonderful railway system. It has been said that during the first year of the war whole army corps, intact, were shuttled across Germany time and again, fifty thousand men, in less than forty-eight hours. When the accompanying artillery, horses, supplies, munitions and transportation are taken into account, it seems almost unbelievable that such an amount of freight, living or dead, could be handled as a body, yet the story of Germany's shifts of force has been proved too often to doubt.

There is practically no change on either line at the moment of writing this article; local activities have occurred, resulting in the occupation of Usciezko by the Russian forces in Bukowina, rendering the security of Czernowitz less sure to Teutonia. On the western line the efforts of Germany to better her position against an expected drive continue, with the loss of a few French trenches in places, offset by gains in others.

Celluloid Covers for the Laboratory

The customary glass dust covers used in the laboratories on various instruments are rather large, exceedingly bulky and quite easily broken. To obviate the use of such covers, a professor in one of the western universities has evolved the idea of using transparent celluloid for the protectors.

These covers have the advantage over those of glass because they are light, they take up much less room because they may be bent to almost any shape, the cost is moderate, and finally they cannot be broken.

The celluloid may be purchased at nearly every stationery store in sheets of any size. The pattern of the cover is traced on the sheet. After the sheet is cut out, holes are punched at intervals around the edges and small eyelets fastened therein. The cover may then be closed by the insertion of a number of common paper fasteners.

Remarkable Art Casting by a New Process

Faithful Reproduction of Sculptured Objects and Plant Life Now Realized in Bronze, Silver, Copper and Other Metals

By Robert G. Skerritt

THE founder sculptor here, has told the sculptor time after time, that he must make changes in his model if he wished it cast in metal. Answered that the old masters did so-and-so, the man of trade and patented processes has uniformly retorted: "Oh, yes, but that is one of the 'lost arts,' and we cannot do those things to-day."

Alfred Lenz, a New York sculptor, has recently demonstrated that the art of the old masters is not a lost one; at least not all lost, and he has proved in the most practical way that objects of great delicacy of form can be reproduced in metal with an astonishing nicety of detail. By way of evidence, he has exhibited floral pieces in bronze, silver and copper made from living models; and his metals have been caused to flow through channels of extremely small dimensions, and then to branch out at the terminal cavities forming perfect replicas in every particular.

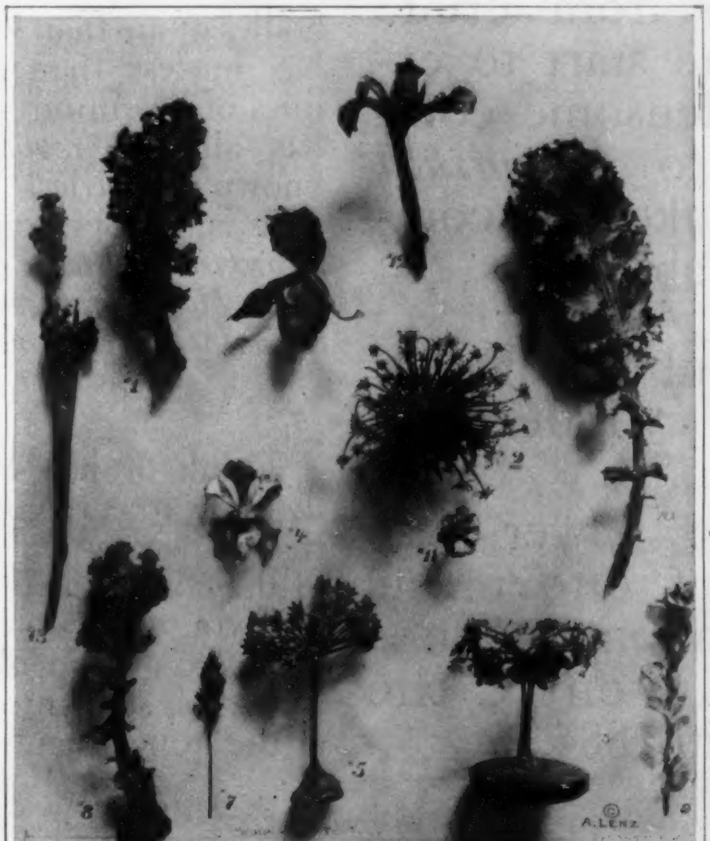
For instance, one of the examples of his combined skill and method is the clustered bloom of the milkweed. Fifty-six separate thin stems radiate from a single parent stalk that is, in itself, of modest size, and at the end of each tiny arm there is a perfect blossom in bronze. Not quite so good from the botanist's standpoint, but yet more remarkable as a technical achievement than the foregoing, is the bloom of the wild carrot, cast in Dawson copper. Here Mr. Lenz has succeeded in getting some exquisite results in many of the terminal blossoms—any one of which would be declared impossible by the best of the professional art founders. The crinkled leaf of Scotch kale has also offered a splendid test for this new-found method of molding, and becomes an object of art when perpetuated in bronze. With equal facility the complex modeling of rare orchids has been reproduced faithfully in bronze and silver.

But Mr. Lenz looks upon these floral pieces as mere incidents in the testing of his process designed primarily to enable him to reproduce in metal the utmost freedom of design. In short, to permit the sculptor to be untrammeled by the limitations imposed by the art founder who, in his turn, is restricted by the more or less complex apparatus which he employs. Not only can Mr. Lenz exercise the utmost liberty in modeling but he is able to cast in metal directly from his original wax "sketch." This makes for spontaneity, grace, and beauty of texture in the metal reproduction.

Heretofore the sculptor has been obliged to make a gelatine mold from his "sketch," and, after removing it from the original model, he has then to cast in that flexible mold a replica in harder wax. This second wax model is not plastic like the "sketch" and it is difficult to work away any surface inequalities that may appear. It is this model that is used by the founder. Mr. Lenz does away with this duplication of work and, as a result, saves time and expense, and, what is still more important to the artist, makes practically a reproduction of the "sketch" in all of its original charm and just as it came from the inspired fingers of its creator—obviously, a great step forward in the art.

The principal reason for his success lies in the character of the materials which Mr. Lenz uses for his molds. This is a mixture of earths that he has discovered only after a great deal of experimenting, and he freely admits his debt to the peoples formerly occupying the Americas of to-day. Samples of their work now extant show that the artist of the centuries long gone had the cunning needful to give his metals wonderful fluidity and knew the sort of material to use for his mold, which would permit him to reproduce lines of beauty and any delicacy of design. With the gold and silver and copper relics of those far-off times have come down to us tell-tale mixtures of earths, and from these Mr. Lenz has obtained a clue which has made his own striking results possible. More than that, because of the nature of his mold mixture, he is not at all hampered by proportions, but says that he can cast objects of any size. This is a great advance in the art.

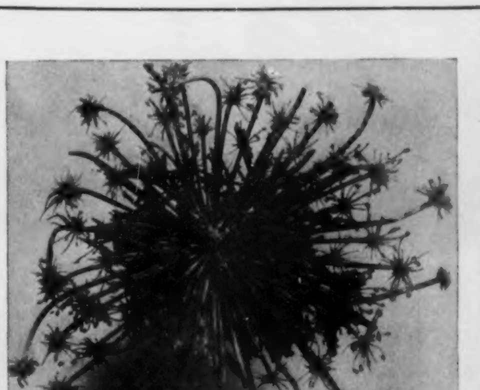
The molding mixture is so fine that it envelops the model intimately and every line and contour leaves its impress when the investment is dried and the waxen figure is melted out. After being heated moderately so as to expel all traces of moisture, the mold is ready to receive the molten metal; and because of the non-conductive character of the earths used this envelope saps so little of the heat from the fluid metal that the latter flows freely through the narrowest of passages and keeps on moving until it has filled up outlying larger cavities, as illustrated so beautifully by some of the floral pieces.



Various specimens of plant life reproduced in metal by a new casting process

In most modern processes the figure desired is only a small part of the total weight of the casting. This is because numerous "feeders" are required to carry the metal to every part of the mold, and these branches must later be cut away from the central castings and the points of contact obliterated carefully and patiently. In the cases of the statuettes illustrated and the flowers shown, but little metal in excess of that visible was needed, and only trifling work has been required, at a single point of exit, to remove the metal that filled the small cavity through which the wax of the original "sketch" was allowed to escape.

There is quite as much of art as there is of craft in Mr. Lanz's method, and while the fundamental secret of his success lies in the formation of his mold, still a considerable part of his remarkable achievements is due to the condition of his metal just before teeming as well as the way in which he actually pours it into his mold. In the case of the floral pieces, the flowers or foliage are pickled. This destroys the woody fibre and gives the plant a leathery consistency that adds to its stability of form. When this has been surrounded by the earthy packing of the mold, and the latter is dried out, then heat enough is applied to decompose the vegetable matter and it is expelled in the form of a gas. How completely this dissolution is effected is made clear by the character of the metal castings.



Above: Clustered bloom of the milkweed reproduced in bronze. Note the remarkable faithfulness of the reproduction, even to the minutest details. On either side: Two statues in metal made by the new process. Practically no finishing has been done on these statues; they appear in the form in which they left the mold.

The International Catalogue of Scientific Literature

THE Smithsonian Institution reports that the European war has interfered seriously with the work and the finances of the International Catalogue of Scientific Literature. In normal times this enterprise was generally in a rather precarious financial condition, and just before the war the receipts and expenditures of the London Central Bureau just balanced. Subscriptions amounting to nearly $6,000 a year, due from five of the belligerent countries, have been either delayed or stopped by the war. The Royal Society has made a grant to make up most of this deficit for the first year of the war, but additional funds now appear to be urgently needed. It is to be hoped that American institutions and individuals will do their share toward tiding over the difficulties of this extremely useful and important undertaking.

THE FRANKLIN CAR

The Most Advanced Type of Motor Construction in the Automobile World

Inspect the Franklin chassis! Notice the freedom from all torque rods and reach rods. Notice the one-piece fastening of the full-elliptic springs—eliminating the usual links, pins and other forgings.

No superfluous parts to driving system. The single-unit direct-connected starter does away with the gears on the fly wheel and the attendant shifting mechanism.

The transmission foot-brake does away with fifty per cent. of the usual rods, rod ends and pins.

* * *

Consider for a moment what such simplicity means in the life of the car, in the ease of control, the saving of time, trouble and upkeep expense.

It is the *mechanical complexity* of the average car that drives its *upkeep cost so unreasonably high.*

Nobody knows this fact better than the Used Car Dealer, who is confronted every day with the problem of selling cars with too much machinery.

The motorist who takes *efficiency* as his measure of value, rather than quantity of mechanism, should know the *Franklin Car*—the most *advanced type of motor construction* in the automobile world.

* * *

The fundamental design of the Franklin is so far in advance that the earliest Franklin Cars produced are doing good service today.

The Franklin was the *first four-cylinder car* built in America—and a six-cylinder car when cars in general were still in the four-cylinder stage.

The *Franklin cylinders had valves-in-head thirteen years* before automobile designers in general took them up.

The Franklin was the *first car with the throttle control*—first with the *single intake trunk*—the first to establish *automatic lubrication*—the first to use *full-elliptic springs without reaches*—the first *light-weight* car and the only *flexibly constructed car today.*

It is the policy of the Franklin Company to build a car that will perform a *service* for the *man who owns it* and for the *dealer who sells it.*

* * *

The Franklin is the only car that has averaged *32.8 and 32.1 miles to the gallon of gasoline in two National Tests.* It is the only six-cylinder car that ever went 55 miles on a gallon of gasoline.

It is the car that is absolutely *free from tire troubles*, and delivers its owners an *average of 9630 miles* to the set of tires.

It is the only car that can run *100 miles on low gear*, anywhere, any time.

It is the car that holds the *world's record for oil economy*—1046 miles on a gallon of oil.

It is the *only car* men and women, old and young, can *ride in all day without fatigue.*

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Performance, service, not "features"—this is the principle of the Franklin Car.

The Franklin Chassis exhibited to the Engineering Class at the Worcester Polytechnic Institute as a demonstration of *finished simplicity in motor car design.* Notice the freedom from all torque rods and reach rods. Notice the one-piece fastening of the full-elliptic springs—eliminating the usual links, pins and other forgings. Consider what such simplicity means in the life of the car, in the ease of control, the saving of time, trouble and upkeep expense.

FRANKLIN AUTOMOBILE COMPANY, SYRACUSE, N. Y.

Roadster—$1900, F.O.B. Syracuse, N. Y.
Actual Scale Weight, 2500 Pounds

Industrial Preparedness for Peace

(*Concluded from page 220*)

It may further be pointed out that in respect to the above raw materials the United States is more independent of outside sources of supply than is any competing nation. The American manufacturer is dependent on South America for his supply of nitrates to be used in the manufacture of nitric acid and on Germany for potash to be used in fertilizers. Aside from these, no material of importance is controlled by outside conditions.

The plant necessary to a dyestuff industry can be designed and made in this country. During the past few months manufacturers of plants have responded nobly to the calls made upon them for new types and large production. They have been compelled by the stress of circumstances to accomplish things which they never thought they could accomplish. Tradition and the fetish of fancied European superiority have been cast to the winds. By coöperation between chemical engineers and manufacturers, all types and sizes of plant necessary can be made here.

From the physical standpoint then the prospect appears bright. Few difficulties are to be met. Of these, none is insuperable to trained men. We can have a dyestuff industry in America if we go at it properly. We may be independent of Europe for our colors if this nation as a nation determines that it will be independent. To do this, the nation must cast aside all carefully nurtured superstitions of European origin. It must be prepared to be patient. All interests must coöperate. We must concentrate. If these determinations are made and adhered to, then the thing is accomplished.

Coming Restoration of the Mississippi as an Important Artery of Commerce

(*Concluded from page 215*)

in handling river traffic, is doomed, and boats will be tied alongside the concrete walls where they will be loaded and unloaded by steel cranes and package conveyors. Modern machinery has sounded the death knell for the occupation of the roustabout and the bugagoo of present traffic conditions—the cost of shore handling. These shore expenses, in the past, have been higher than the actual cost of transportation, and when they are eliminated the river cities will be served by 1,000-ton steel barges of the type now building.

An illustration of the possibilities to be found in the use of the river for freight purposes is that of the tow boat "Sprague," which plies between Ohio river points and New Orleans as a coal carrier during the high water season. The "Sprague" can tow 65,000 tons of coal down-stream on one trip, and can push 40 empty barges up-stream on the return trip at a fair rate of speed. Despite the fact that the "Sprague" is only available for service during the high water season, its owners have found it extremely profitable as a shipping venture.

The Inland Navigation company, a $9,000,000 corporation, is building a fleet of 36 1,000-ton steel barges, all to be equipped with wireless and the most modern equipment. These boats require such a light draft that they can traverse the entire 2,000 miles of the waterway at a speed of from eight to fourteen knots an hour during the entire navigation season. One a month can be built in some of the small southern shipyards, so their installation is simply a matter of the completion of the modern terminals needed to make their use a successful venture.

"Mississippi steamboating," Mark Twain wrote, "was born in 1812; at the end of 30 years it had grown to mighty proportions, and in less than 30 years it was dead." The railroads and the tow boats killed the steamboat and, in turn, the lack of improved terminals has killed the tow boat, so that it no longer is used on an extensive scale on the river.

"When there used to be 4,000 steamboats and 10,000 acres of coal barges and

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rafts and trading scows," Uncle Memford, one of Twain's river friends, said, "there wasn't a lantern from St. Paul to New Orleans and the snags were thicker than bristles on a hog's back; and now, when there's three dozen steamboats and nary barges and rafts, the Government has snatched out all of the snags and lit up the shores like Broadway and a boat's as safe as she would be in heaven."

This is why river men believe the time is ripe for the restoration of inland navigation on the Mississippi, for, they say, the Government has done its share of the preliminary work.

General Staff Maps

(*Concluded from page 221*)

sloping is even or whether it changes abruptly and unevenly is not perceivable from such a map.

To improve this, Colonel Lehman invented his clever scale. In theory he considered the terrain as a mercatorial plan. Which means a flatly spread country, ignoring the fact that the earth is a globe. Since those maps are taken up at the scale of 1:25000 or 1:12500, this involves small sections and the differences are later easily adjusted to the globe system. Next to this Lehman has considered the light as a parallel and not a central light, then he stated that if a perfectly flat surface of a square inch would take off 100 rays of this parallel light, then the same surface would appear white on the map. Now, then, if that surface is elevated at one end, in the eyes of the military map maker, it will get darker, for the simple reason that (according to Lehman's theory), a fewer number of light rays will fall on it.

Once this is understood, the student of military maps will very easily see the character of the terrain between the contour lines. But to make the degree of elevation directly readable, one has to train his eyes to the shades of the slopes. The best maps are those where the scale is expressed by lines. These lines can be easily compared with a specially prepared scale of the degrees.

To show other unevennesses of the ground, special signs are adopted, such as ravines, rocks, overhanging walls, etc.

The Military Geographical Institute of Vienna is one of the most completely equipped establishments of its kind. It is a school for officers who possess special ability in these lines and who are commanded to attend this particular study of making and correcting military maps.

Every section is revised at ten-year intervals. In wooded countries and where, through cutting, the forest undergoes important changes, such revisions are made even oftener. Thus the records of the country's terrain are kept as nearly up to date as possible.

The work of procuring foreign maps is not so interesting for the United States. There are no tendencies toward enmity with neighbors; yet, even so, good maps are of such valuable aid to the army that no money should be spared to procure them.

The making of maps from the point where the mapping squad receives its three or more triangulation points, to start with, points astronomically fixed, which are marked and established by the land title institution, to the point of the finished product, is a long and tedious process. It involves all the engineering sciences applied to military needs and all the most improved methods of reproduction and printing, involving color processes and lithography.

Preparing to Meet a Coal Shortage

(*Concluded from page 223*)

furnish electric light and power at Chicago and New York, regularly maintain large stocks of coal. These companies, which use slack and the cheaper grades of coal, have several objects in view in storing, not the least of which is equalizing the cost of their fuel by buying only when prices are low.

It is well known that soft coal is liable to take fire by spontaneous combustion. It was formerly supposed that the sulfur in the coal was in some way responsible for this phenomenon, but it is now gen-

erally understood that what really takes place when coal is exposed to the air is a very slow oxidation, or burning, and that if confined, the small amount of heat thus generated accumulates until it is sufficient to ignite the coal. It has been found that the danger of spontaneous combustion in open storage can be readily decreased, if not eliminated, by limiting the height of the pile and by having the heaps well ventilated. The large storage plants now being constructed at the Panama Canal are designed to hold a total of over half a million tons of coal in exposed piles 20 feet deep. At that depth each square foot of storage space will hold half a ton of coal. A convenient and ready means for determining when a storage heap is becoming overheated is to drive a small iron rod or pipe into the coal. If on removal, after being in several hours, the bar is too hot to be held in the bare hand, the coal may be considered near the point of ignition and should be dug out and watered.

Storage under water will absolutely prevent spontaneous combustion. This method has been installed in a few localities, notably in the middle west, around Chicago, but has not come into general use because of the cost. One of the first large plants for submerged storage of coal was built in Illinois by the Western Electric Company, more than eight years ago. The coal was dumped from cars on trestles into concrete-lined pits and flooded. At the Isthmus of Panama submerged storage is being provided for 150,000 tons of coal.

It has been suggested that abandoned rock quarries now full of water are good pits in which to store coal, and the idea appears to be sound. The coal could easily be put into and taken from such holes in the ground by means of a locomotive crane and grab bucket. Doubtless some of the abandoned quarries at Quincy (near Boston), at Milford (near Worcester), and at East Long Meadow (near Springfield), in Massachusetts, or those at Bedford and Bloomington, Indiana, at Joliet, Illinois, or some of the old slate quarries near Philadelphia, and granite quarries around Baltimore, will be found suitable as regards location to transportation facilities, and as regards size and depth to warrant their use as pits for the submerged storage of coal. Most of the illustrations in this article appear by courtesy of the Brown Hoisting Machinery Company.

Errata

THE articles on The Potash Famine and The American Declaration of Economic Independence which appeared in our issues of February 5th and February 12th, respectively, contained a number of typographical errors. In the diagram at the bottom of page 146, "sixteen thousand lbs." should read "sixteen hundred lbs." Part of the legend under the diagram was omitted, namely, the explanation that the "consumption of potash is calculated in pounds per hundred acres of arable land."

In the second article, on page 177, at the middle of the third column, the amounts are given in "millions" instead of "billions." The text should read, "The colors for our vast textile industry, with an annual output worth $1,640,000,000, our leather, paper, ink, paint and varnish branches, with a total output valued at $1,550,000,000 and scores of minor industries, originated chiefly in Germany. The complete list would be of great length." Near the bottom of this column, the reference to the "output of so-called coal-tar crudes" should read as follows: "The *monthly* output of these products at present is about 12,150 tons. (This includes 830 tons of synthetic phenol. The 750 tons of benzol required in its preparation should therefore be deducted from the above figure, leaving a net total of 11,400 tons.)" And on page 184, at the end of the first paragraph, "eighteen thousand tons" should be changed to "fifteen thousand tons" as the annual rate of manufacturing artificial colors by twelve American companies.

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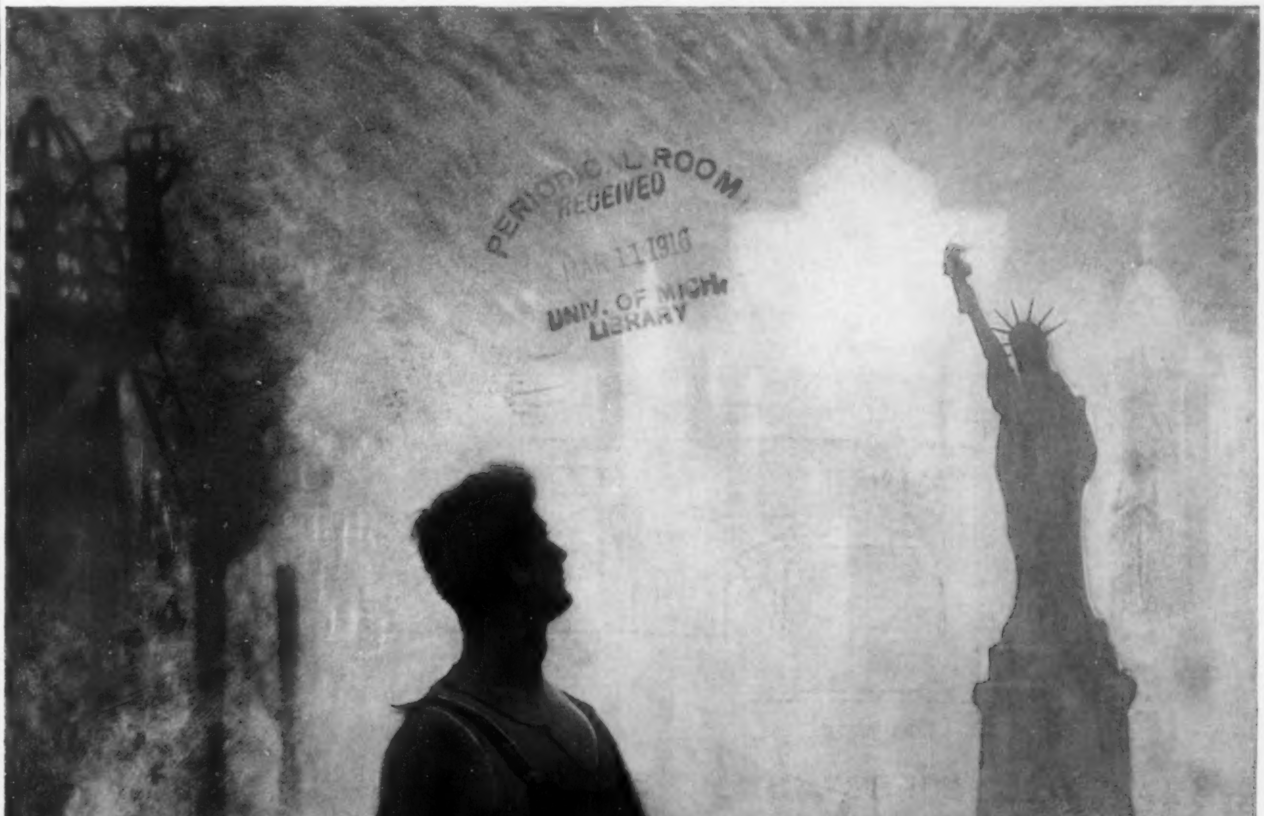

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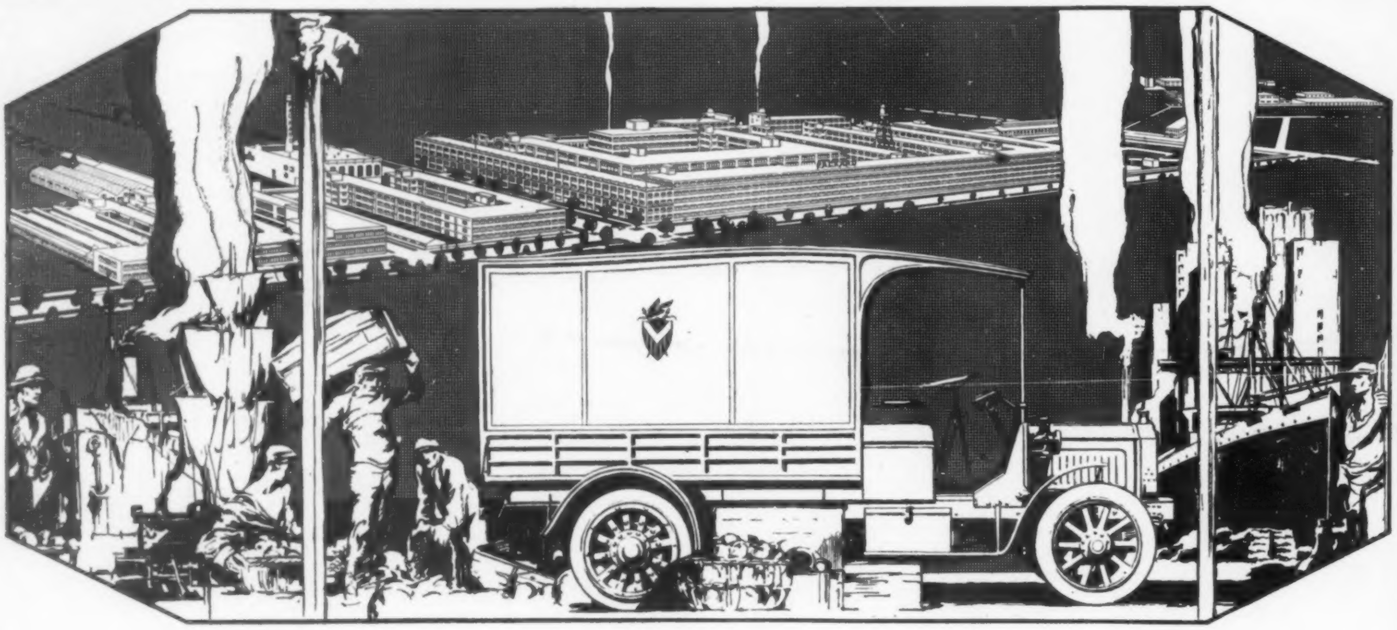

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